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Sign of the Times. IN a recent number of an English electrical journal, among eighteen notes on one page, eleven concerned electrical matters in America, and on the next page the proportion was nearly as great. In another English journal we noticed that over half the editorial space, consisting of a number of pages, was devoted to American matters. It cannot fail to be gratifying to Americans to see that the importance of the work done here is being recognized abroad.

The Western Electric Company at the World's Fair. One of the most interesting as well as one of the most elaborate of the electrical exhibits at the World's Fair is that of the Western Electric Company, so completely illustrated and described in this issue. This company has not only made a very admirable collection of the various pieces of apparatus which it manufactures, but it has arranged a display so varied and tasteful that it attracts both those who are directly interested in this line and the general visitor as well. From an educational standpoint it ranks among the most important of the exhibits and should not fail to be of great value in that respect. This is a feature which some of the exhibitors have taken care to develop, with the most encouraging results. The Western Electric Company has not only a most attractive exhibit, but its representatives have made every effort to gratify public curiosity by explaining all its details, and have given the representatives of the press all the assistance in their power, a policy considerably at variance with that of many of its rival exhibitors. That such a course tends to bring its display into greater prominence and thus to familiarze the public with its character, is indisputalbe.

Cooking by Electricity. THE great advances recently made in electrical cooking utensils and the long-deferred commercial basis upon which this branch of electrical industry seems at last to be placed, point to a very general advance in this direction in the near future, if the claims in regard to cost are confirmed, and of this there seems to be little doubt. One of the effects of the new method will undoubtedly be an advance in the art of cookery itself, not only owing to the great facility in which the heat may be applied to exactly accomplish any desired effect, but also through the discomfort in the manual practice of the art being almost entirely obviated. In roasting or baking, for example, the heat may be controlled to a nicety and equally applied from all sides of the oven, and the exterior of the apparatus kept so cool as not to appreciably raise the temperature of the surrounding air. Owing to this ability to control the temperature of cooking, the exact time and temperature required for a given dish to be done so as to bring out perfectly the best flavor will become known, and as a consequence ordinary cooking will be reduced to a simple mechanical operation, and an ignorant servant who can merely read a thermometer may be able to produce results almost equal to those of a *chef*. Owing, however, to the entire lack of discomfort and uncleanliness the art of Brillat Savarin may come generally to be accepted as a fine art, and its practice, at least as far as the cooking itself is concerned, regarded in the light of an accomplishment worthy to be exercised only by those who can appreciate its refinements. Indeed, with apparatus admitting of the most scrupulous cleanliness, and with an entire absence of exterior heat, the modern kitchen is likely to become one of the attractive departments of a house, and have lavished upon it artistic decorations in keeping with the character of those which can be easily given to the utensils themselves. The electric light has shown what can be accomplished through it in interior decoration, and electric cooking admits of similar improvements in that dark spot in the household, the present kitchen, with its uninviting interior, unsavory odors and distressing heat.

A New Form of Dynamo. IN the Digest of the two preceding issues are contained abstracts of a recent important paper read by Mr. W. B. Sayers before the English Institute of Electrical Engineers and of the discussion of the same. The paper has excited the liveliest interest in England and is generally considered to have opened up a new field in continous current dynamo design. The description in the Digest gives very clearly the theory of the new winding, which is so simple that it seems extraordinary it had not been discovered long before this, and it appears, indeed, that an American electrician, Mr. Eickemeyer, has employed a somewhat similar device to get rid of sparking. The principle is briefly as follows: Instead of leading the armature coil connections to the commutator directly, as usual, they are instead connected with one end of a supplementary coil which is under or near one of the pole projections when the armature coils between which it is connected are at their neutral position; the other end of the coil is led back to the commutator segment to which otherwise the armature coil would have been directly connected. The supplementary coil is thus in an active part of the field and generates the E. M. F. to reverse the current, therefore obviating sparking, which is otherwise done in the usual dynamo by advancing the lead of the brush so that the necessary E. M. F. is created in the coil itself that is being commutated. Two important results of the principle are that the air space may be reduced to a minimum and the fields excited by the armature itself, using no field coils. In ordinary dynamos the air gap cannot be reduced below a certain amount without causing sparking; but by means of the supplementary coil, which may be adjusted to any E. M. F. to control sparking, there is no limit to the smallness of the gap except a mechanical one, and it can be made very small with armatures having the wires in grooves or in passages in the body of the armature, as in the Wenstrom and Brown types. As the greater number of ampère turns on the field of a dynamo is required to force the lines of force through the air gap, amounting to 90 per cent. or more in an ordinary 100 light machine, the saving in this respect is at once evident. As sparking in all cases can be prevented, the fields of dynamos or motors may be excited by the armature magnetic induction itself, by giving the brushes of the former a backward and those of the latter a forward lead, thus dispensing with field coils. This seems, however, to apply only to series wound machines or to the series coil of compound wound machines, but it cannot yet be said positively if this is the case. Altogether, the paper of Mr. Sayers is one of the most fruitful of late years; and although all of its promises may not be fulfilled, the probabilities are that continuous current dynamo and motor design at least will be largely modified by it.

Education of Engineers. AN ever-recurring topic is that of the education of engineers, and the divergence of views on the subject is not only great, but the differences seem to be irreconcilable. A few years ago the administrative head of a celebrated engineering school in a commencement address took the ground that the prime object of a professional school should be to train the intellect and store the mind with technical philosophy and principles, and thus, he claimed, develop and broaden the higher faculties, elevate the personality and make the graduate a leader among men. It was maintained that too great devotion to detail and manual training had an opposite effect, and that the first years of professional life would supply the practical experience and details incident to the line of work taken up in a greatly more effective manner than the necessarily superficial methods of the laboratory and school workshop, the amateur character and great range of which bear little relation to the earnest and special work of a professional career. On the other hand there are engineering schools that lay the greatest stress on the laboratory and workshop; that maintain that all of the manual operations within the cognizance of a profession, even the menial ones, should be taught and that higher theories are only useful in proportion to their direct practical bearing. Between these extreme views there are all gradations, including the "happy mean," which, like most compromises, is likely to be more unsatisfactory than either of the extremes which at least have the merit of being based upon positive convictions. Everything, of course, depends upon the point of view, upon the conception of the object to be attained and of the method to be pursued, which again depend largely upon the personal experience and mental characteristics of the exponent of a system. On the one hand the representative is an Ericsson who, when asked to be present at the trial trip of the Monitor, replied that Napoleon did not attend company drill; on the other hand is a Stephenson whose study isthe workshop. As in every case in which difference of opinion is developed among able men, both views are doubtless right from the standpoint assumed and the view to be adopted in any case should be decided from the circumstances of that case rather than from reference to a set of arbitrary rules which perhaps do not apply exactly to any specific case, and may widely depart from the one under consideration. For the ambitious with the courage to endure the struggles of the first years, or with the means or influence to ease the way to preferment, and with also the ability and character necessary for the honors aspired to, the first method appears to be the best, while in any case the superior mental tone imparted by it is likely to compensate to a greater or less extent for practical shortcomings. For the average person, however, and for those who wish to develop their earning capacity at once or who desire numerous, though, in the final effect, uncertain opportunities, the second method appears to possess advantages, although it should be borne in mind too good a preparation for minor positions may tend to lessen striving for the higher and more difficult ones. In either case, the superior character will gravitate to the top and ability will assert itself over the limitations of the system. A conclusion that seems to be inevitable is that the system is the best that allows the greatest latitude, and that elective courses in engineering schools are no less valuable than they have proved to be in general scientific and other courses. A rigid system must either adjust itself to the average, and thus place a premium on mediocrity, or only prove of benefit to those whose circumstances or mental characteristics come within its pale. The young man who feels that his forte is constructive engineering should not be compelled to waste his time on laboratory minutiæ, nor the prospective laboratory expert required to lay down the plans of a street railway installation. In this period of professional specialization a professional school that does not specialize its course is not in sympathy with the spirit of the age.

Some More Notes on that Badge, and Inferentially on People Who Live in Glass Houses.

BY W. J. HAMMER.

In The Electrical World, under the date of June 10, 1893, appears an article entitled, "Some Notes on that Badge and Incidentally on the Origin of Electricity," by Mr. Park Benjamin.

As I have the honor of being not only a member of the Committee on Badge and Certificate, but the designer of the official badge which was adopted by the American Institute of Electrical Engineers, it will perhaps not be out of place for me to reply to Mr. Benjamin's communication.

In the first place, in no communication issued by the committee has it been stated that the outline of the badge was that of Franklin's kite. The postal cards which were sent to the members and to the press stated that the badge embodied certain characteristics, among others Franklin's kite. It was not stated that it was an exact reproduction of Franklin's kite, and it is even doubtful whether Franklin's kite, as suggested by Mr. Benjamin, was square. I believe silk handkerchiefs are not ordinarily square, as stated by Mr. Benjamin, and on measuring two which I have in my pocket, I find them considerably longer in one direction than in the other. It is not unlikely that Franklin so stretched his silk handkerchief that the kite was very nearly the shape and form of the badge. However, such a criticism is scarcely worthy of notice.

The original design of the badge contained no compass marks, these being added by the engraver, and as the electrotypes were delivered at the time of the annual meeting it was imposible to correct this. Those used on the postal cards that were sent out and given to the electrical papers were thus marked, although the badge as it appears upon the certificate and upon all the official papers and documents of the Institute contained no such marks.

In the original design the galvanometer needle was placed upon a wire connecting the galvanometer, but having the appearance of a continuation of the wire; it was placed at right angles to this position, and is not only more artistic in this position, as all will doubtless agree, but, as Mr. Benjamin is certainly aware, would be the correct position of the needle if the galvanometer should be turned round or the coil set in a certain position. Again, if the bridge is out of balance, the needle will take up different positions, according to the amount of current which is sent through the galvanometer coil.

Mr. Benjamin takes exception to the statement that the amber of which the galvanometer is made represents the first conception of electricity, dating back to 600 years B. C., when Thales, the Greek philosopher, recorded the fact that amber, when rubbed, attracted light particles, and the Greeks worshiped it, believing that the gods had endowed it with life and that it possessed a soul. He (Mr. Benjamin) said: "To begin with, the first conception of electricity does not date back to 600 B. C. There was no conception of electricity at all at that time. If Thales recorded the fact, it would be interesting to know where he did it, and on what authority the assertion is made." At the time I prepared the description of the badge I consulted many of the highest authorities, among others Tyndall's "Lessons on Electricity," Maxwell's "Treatise on Electricity," Thomson and Guillemin's work on "Electricity and Magnetism," J. Monroe's "Pioneers of Electricity," Ganot's "Physics," Deschanel's "Philosophy," Gilbert's "De Magnete," Houston and Sloan's "Electrical Dictionaries," Routledge's "Popular History of Science," Urbanitzky and Wormell's book on "Electricity in the Service of Man," John T. Sprague's "Electricity: Its Theory, Sources and Application," L. Figuier's "Les Grandes Inventions" and other well known authorities, who, without exception, make the statement referred to by me. Even these excellent authorities did not entirely satisfy me, so I turned to one whose infallibility Mr. Benjamin will perhaps not call into question. If he will refer to his own book, entitled, "The Age of Electricity from the Amber-Soul to the Telephone," he will find upon page 4 the following statement: "As the world grew older, here and there in the writings of the philosophers references to this strange property of amber appear. Thales, in the year 600 B. C., mentions it, and, being the earliest writer who has been found to do so, is too often credited with the discovery."

As Mr. Benjamin criticises my statement that the Greeks worshiped amber, believing the gods had endowed it with life and that it possessed a soul, he might again refer to his book on page 4 and read as follows: "And so, perhaps because of this legend, the Greeks looked upon amber with superstitious reverence, and even thought that it had a soul, for when it was rubbed it seemed to live and exercise attraction upon other things distant from it. . . . Thus they speculated upon an amber life, and an amber soul as its essence."

Mr. Benjamin, in the fourth paragraph of his article, says: "Here is another statement. In the year 1600 Dr. Gilbert, Court Physician to Queen Elizabeth, coined the word electricity from the word electron, the Greek name for amber." To quote Mr. Benjamin's own words, which might perhaps be better expressed: "Gilbert didn't do anything of the sort; what he did do was to give the name electrica to certain substances, which he for the first time discovered would attract light bodies, and which act (as he says) for the same reason as amber. Gilbert derives the word not from the Greek electron, but from the Latin electrum." Upon this point I wish again to state that each and all of the authorities referred to above support me in these statements. However, in order that there may be no question as to the reliability of the sources of my information, I would again call attention to Mr. Benjamin's book, on page 7 of which occurs the following: "In the year 1600 Dr. William Gilbert, of London, surgeon to Queen Elizabeth, published his famous work 'De Magnete,' and then made known that the attractive property of amber, when rubbed, was not inherent to that substance, but existed in some twenty other bodies, such as the precious stones, glass, sealing-wax, sulphur and resin. Inasmuch as these all acted like amber, Gilbert called them electrics; and he described the peculiar phenomenon itself as electricity, deriving the term from the Greek word for amber, electron."

Non-Synchronous Alternating Current Motors.

BY H. BEHN-ESCHENBURG.

In the first and second sections of my article on non-synchronous alternating current motor in The Electrical World of May 13 and 20, 1893, the turning moment of a polyphase motor is calculated by formulas (3) and (8), when it may be assumed that the leakage of the magnetic system is negligible. Practically this case often may not be realized. Then in formula (8) the value of $(Ll - M^2$ signifies the leakage, and when it is large compared with $\frac{R\rho}{2\pi(n - n_1)}$ and $\frac{L r}{2\pi(n - n_1)}$ we have by a somewhat similar development to that in formula (3) the turning moment:

$$D = \frac{E^2 M^2 r}{(2\pi n)^2 2\pi (n - n_1) \Delta^2}$$

Here $\Delta = Ll - M^2$ = the value of the leakage; i. e., when the leakage is large the turning moment increases with increasing secondary resistance and with increasing speed, until the motor nearly attains synchronous motion. That is a similar relation to that in formula (4); and a motor with large leakage shows synchronous qualities.

In the same article, on page 272 in the issue of May 20, the expression for the coefficient of self-induction should be $L = \frac{Z^2 4\pi}{W}$, instead of $L = \frac{Z^2 (4\pi)^2}{W}$.

Effective Alternating Currents and Electromotive Forces.

BY A. E. KENNELLY.

Since in dealing with alternating current circuits, the terms "mean current," "square root of mean square" and "effective current" are sometimes not clearly understood, a few remarks upon the subject may not be unacceptable.

Suppose that in a circuit we have a current alternating, between the limits of 10 amperes positive and 10 amperes negative, say 200 times in a second. The mean or numerical average current strength will be some value between 0 and 10, depending upon the shape of the current wave. With a simple zigzag wave, the mean current would be 5 amperes, for semi-circular waves 7.854 amperes, and with sine waves 6.367 amperes.

But in the most important practical applications of electric currents, the effect depends upon the square of the current strength. The rate of developing heat in a constant resistance is a prominent instance, and incandescent lamps may be practically included in the same category. When the current through such a resistance is doubled, the rate at which the heat is generated therein is quadrupled. If the current periodically alternates or fluctuates, the same quantity of heat will be developed in a given interval of time (including many cycles), if the average square of the alternating current is equal to the square of the uniform continuous current strength. Just what maxima the cycles will reach when this condition is maintained will depend upon the shape of the current wave; but if the wave happens to be a sinusoid, with a maximum of 10 amperes, whose square is 100, the mean square over the cycle is just half this maximum square, or 50, and the heating effect of this alternating current would be equal to that of a continuous current whose square was 50; that is, whose strength was 7.07 amperes.

The "effective" strength of any fluctuating or alternating current is thus the square root of its average square; and if we know this effective strength, we know the heating power of the current, without requiring any knowledge of the wave shapes.

The mean strength of a current measures, then, the quantity of electricity that would flow through the circuit in a given time, without regard to direction. The "effective current," or square root of the mean square, measures the thermic activity that the current will develop in a resistance. The mean strength of an alternating current would be indicated by a D'Arsonval galvanometer if the waves were all "rectified," or delivered to it in the same direction with the aid of a commutator. The "effective" current strength would, on the other hand, be indicated by an ammeter of the dynamometer type, with or without rectification, since the deflections of such instruments are independent of the direction, but proportional to the square of the traversing current's strength. If this square fluctuates, they point out the average square.

Similarly, the "effective" voltage of a periodically varying E. M. F. is equal to that uniform continuous E. M. F. which, applied to a simple non-inductive resistance, would generate therein the same amount of heat in a given time sufficiently long to include a number of cycles and obtain a fair average. Since the thermal activity of an E. M. F. applied to a fixed resistance is proportional to the square of the voltage, the effective value will be the square root of its average square.

The term "effective," chosen by the Paris Congress of 1889, may be understood as "effectively equivalent in thermal activity."

All alternating current voltmeters and ammeters are in practice calibrated to "effective values." By this means, an incandescent lamp, which is brought to full illumination on a continuous current circuit by half an ampere, or by 100 volts, will be brought to full illumination by these same quantities of current and voltage on an alternating current circuit, no matter what the shape of wave, assuming, of course, as experiment shows, we may, that the "skin effective" and the inductance in the lamp filament are negligible. If, on the other hand, alternating current apparatus were calibrated in "mean" values, the voltage or current necessary to supply lamps at normal candle power would not only differ from the corresponding continuous current values, but would also depend upon the shape of the alternating waves.

Currents from Commercial Circuits for Medical Purposes.

BY GANO S. DUNN.

In The Electrical World, May 20, is an article by Dr. Waite stating that he believes it dangerous to the patient to use current from street wires for medical purposes, because of the liability of crosses with high tension circuits, and asking for a discussion of the subject in the electrical press. This is answered by Dr. Hutchinson, in the issue of May 27, saying that he believes the danger is remote, but that the patient in any case would be protected by a delicate fuse and a lamp placed across the circuit before it entered the medical apparatus.

While the writer believes that the danger is extremely remote, yet it is present under certain conditions, and is not removed by the above means. Suppose, during cauterization of the nostril by current taken through a lamp from an overhead two-wire ungrounded incandescent system, the patient is seated in an iron chair such as dentists use, which by proximity to running water, a nail or moisture in the floor, or other cause, is grounded.

A cross with a high-tension circuit in the street under these circumstances would, if it did not kill the patient, at least give a very severe and dangerous shock. This would occur also in a three-wire system, in which neutral was not grounded.

In a system of magnitude, however, in which the neutral or one side of the circuit is connected with the ground, the danger is absent since the high-tension current can get to the ground without going through the patient, even if it has first to pass from the ungrounded to the grounded side of the system through the lamps. I have said above a system of magnitude, since it is possible, if there are comparatively few lamps across the circuit and the falling wire is that from a large railway power house, the current will burn out all the lamps, blow the fuses that connect them with their generator, and leave the patient the only path between the trolley circuit and the ground.

Absolute protection may be secured, however, in every case by the insertion between the circuit which comes from the street and the circuit which goes to the patient of a direct current transformer. This renders the two circuits entirely distinct and separate from each other; so much so, that a one thousand volt alternating current, which is fatal, could be crossed with the lighting circuit without the patient or the physician knowing it.

Direct current transformers, with voltage of secondary same as voltage of primary, have already been manufactured for somewhat similar purposes to the above, and not only would they give perfect immunity from danger, but, if desired, could be wound to deliver a current of low voltage just suited to the cautery wire, so that the lamps usually in series with the latter to cut down the voltage of the mains could be dispensed with, and the rupturing of the cautery wire, due to overheating, would not cause a potential difference of one hundred and ten volts in the patient's nose or mouth.

BY WM. CONNELL.

I have read the communication of Dr. Waite in The Electrical World of May 20, and that of Dr. Hutchinson in the issue of May 27, and I am of the opinion of the

editor of The Electrical World, that a patient may receive a dangerous shock while under electro-medical treatment, with a current from a commercial circuit, on account of a cross with an arc light or other high tension wire. Although the patient may be protected by a fuse or circuit breaker, this would last just long enough, even if but the fractional part of a second, for the patient to receive a dangerous shock.

Many medical practitioners who are on the line of an incandescent circuit can depend on it only from 6 p. m. until 8 a. m., which is unsatisfactory, as the most important cases are treated, and I believe should be treated, in the day time. I would therefore suggest the following apparatus, to be under the control of the operating physician, and available at all times, and having no direct connection with the commercial lighting circuit.

To the commercial circuit I would connect a one-quarter horse-power direct current or alternating motor, according to the system that is used, and belt the motor to a small dynamo with regulating apparatus, so that the voltage can be regulated to suit the requirements of the case under treatment. This same dynamo can be used for charging storage cells, which may be used for cautery work as well as for other purposes.

If there is only a night service I would suggest the same arrangement in connection with storage cells, with the addition of a battery motor to run a small dynamo in case higher voltages than that of the storage battery are required. The motor can also be used in either case for running drills, fans, etc.

In addition to the ordinary storage cells a smaller set may be fitted up in a case suitable for carrying around to the patient's residence, when they cannot be treated at the physician's office, or such cases can also be treated at the patient's residence by moving part of the apparatus there, and connecting with his lighting service.

By the use of the above I believe that all physicians would be in a better position for first-class operations than if dependent entirely on battery current which may give out in the middle of an operation, or dependent on a lighting circuit with its dangers. In the latter case the current can be used directly from an incandescent lighting circuit for years with no mishap, and yet the thousandth case may be accompanied with a dangerous shock and serious results.

In the above arrangement if there is a cross with an arc or some other equally dangerous wire the current that would enter the office of the practitioner would blow the fuse, or if the fuse did not blow the motor would be burnt out and the dynamo not touched, as it has no electrical connection with the motor or lighting current.

I am not a physician and therefore do not know all the requirements of the medical practitioner, but I have been interested enough to present the above solution of the problem set forth by Dr. Waite.

Long-Distance Electric Transmission of Power.—II.*

BY W. F. C. HASSON.

In determining the feasibility of utilizing water power to operate electrically the industries of any particular town or city, careful consideration must be given to the following points, viz.: 1. The amount of water power permanently available. 2. The cost of developing this power. 3. The interest on this amount. 4. The total demand for power. 5. The amounts and relative locations of the various kinds of power. 6. The cost of steam plants now in operation. 7. The interest on this amount. 8. Cost of fuel for plants now in operation. 9. Cost of operating present plants. Labor. 10. Cost of maintenance of present plants. 11. The amounts and kinds of electric power already in operation. 12. The distance of transmission. 13. The estimated cost of the hydraulic machinery. 14. The guaranteed efficiency and regulation of the hydraulic machinery. 15. Estimated cost of electric machinery. 16. Estimated cost of line construction. 17. Total cost of operating hydraulic and electric machinery. 18. Total cost of maintenance of hydraulic and electric plants. 19. The interest on the total estimated cost of proposed plant. 20. The estimated gross income.

Undoubtedly, cheap power is essential to the development of the latent industries of California. It is equally true that the reliable electrical manufacturing companies are now prepared to furnish machinery to provide cheap power. The only difficulty in the way of advance appears to be a lack of confidence on the part of possible purchasers. This lack of confidence appears to be due to their inability to reconcile the conflicting claims and statements made by the electrical companies concerning their own machinery and that of competing companies.

Many transmissions that are easily possible are by no means feasible. No long-distance transmission is absolutely impossible, although it may be thoroughly impracticable. Whatever system is adopted, the cost of generators and motors will not vary greatly, and the important factor in a long-distance transmission is the amount of copper necessary for the line.

In order to show how the amount of necessary copper may be varied, I have compiled the following tables, which give the weight and cost of copper necessary to transmit a single horse power various distances with varying line losses when the initial electromotive force varies from 500 to 20,000 volts. In these tables the transmitting line only is considered, and no attention is paid to the efficiency of generators, motors, or the transformers that would be necessary for the transmission of the higher electromotive forces.

To determine the cost, copper is taken at a uniform price of sixteen and two-thirds cents per pound. This is above the market price to-day, but it is a safe figure and sufficiently accurate for the purposes of comparison.

These tabulated figures appear very interesting, and I regret that they are not absolutely true. They are correct as regards the passage of a continuous current over a perfectly taut two-wire line in a country where small variations of temperature occur. In calculating them no attention has been given to the effects due to static capacity nor to self and mutual induction in long transmission lines with alternating currents.

Other points to be considered are—Standard size of wire; safe current-carrying capacity of wires; necessary sag in the line; limits to stable construction.

The corrections due to these considerations will depend upon the system adopted and the amount of power to be transmitted. Their effect will be similar on the data given, and the tables are sufficiently accurate for purposes of comparison and general estimates. Each electric transmission is a problem by itself, and in order to be successful must be solved in accordance with the rules of good engineering practice.

TABLE I.—FIVE, TEN AND FIFTEEN-MILE TRANSMISSION.

Initial E. M. F.	Final E. M. F.	Line loss per cent.	Cost of copper per h. p., delivered.		
			5 miles.	10 miles.	15 miles.
555	500	10	$39.00	.....	.....
588	500	15	251.00	$1,006.00	$2,265.00
625	500	20	177.00	711 00	1,599 00
1,110	1,000	10	100.00	.....	.....
1,176	1,000	15	62 00	251.00	566.00
1,225	1,000	20	44.00	177.00	399.00
2,220	2,000	10	25.00	100.00	225.00
2,352	2,000	15	15.50	62.00	141 00
2,500	2,000	20	11.00	44.00	100.00
3,330	3,000	10	11.00	44.00	100.00
3,528	3,000	15	7.00	28 00	62 00
3,750	3,000	20	5.00	19.00	44.00
4,440	4,000	10	.....	25.00	56.00
4,700	4,000	15	.....	15.50	35.00
5,000	4,000	20	.....	11.00	25.00

TABLE II.—TRANSMISSION AT 10,000 AND 20,000 VOLTS INITIAL ELECTROMOTIVE FORCE.

Distance, miles.	Line loss, per cent.	Cost of copper per horse power delivered.	
		10,000 volts.	20,000 volts.
20	10	$19.60	$5.00
20	15	14.00	3.50
20	20	11.10	2.83
25	10	31.00	7.66
25	15	21.60	5 50
25	20	17.30	4.30
25	25	15.00	3.60
30	10	44.30	11.00
30	15	31 30	7.80
30	20	25.00	6.25
30	25	21.30	5.30
30	30	19.00	4.80
35	10	60.50	15.10
35	15	42 60	10.60
35	20	34.60	8.50
35	25	29.00	7.10
35	30	26.00	6.50
35	35	24.00	6.00
40	10	79.00	19.60
40	15	55 60	14.00
40	20	44.30	11.00
40	25	38.00	9.50
40	30	34.00	8.50
40	35	31.30	7.80
40	40	29.60	7.30

TABLE III

TRANSMISSION OF THE OUTPUT OF A 500-KW. GENERATOR.

E. M. F. Motor.	E. M. F. Generator.	Line Loss.	Efficient Output Motor.	Efficiency Generator Axle to Motor Axle.	Pounds of Copper Wire to Transmit—			
Volts.	Volts.	%	H. P.	%	5 miles.	10 miles.	15 miles.	20 miles.
1,000	1,111	10	554 8	76.2	361,574	1,446,295	3,254,164	5,785,180
2,000	2,222	10	554.8	76.2	90,394	361,574	813,541	1,446,.95
3,000	3,333	10	554.8	76.2	40,175	160,699	361,571	642,789
4,000	4,444	10	554.8	76.2	22,599	90,394	203,385	361,574
1,000	1,176	15	523.9	72	215,010	860,040	1,935,090	3,440,160
2,000	2,352	15	523.9	72	53,752	215,010	483,772	860,040
3,000	3,528	15	523.9	72	23,779	95,960	215,010	382,240
4,000	4,704	15	525 9	72	13,444	53,752	120,943	215,010
1,000	1,250	20	493.1	67.7	142,844	571,376	1,285,596	2,285,504
2,000	2,500	20	493.1	67.7	35,711	142,844	321,399	571,376
3,000	3,750	20	493.1	67 7	15,871	63,486	142,844	253,944
4 000	5,000	20	493.1	67.7	8,928	35,711	80 319	142,844
1,000	1.333	25	462.3	63.5	100,137	401,718	903,934	1,6 6,992
2,000	2,666	25	462.3	63.5	25,109	100,437	225,983	401,748
3,000	4,000	25	462.3	63.5	11,159	44,638	100,437	178,554
1,000	1,428	30	431.5	59.3	72,910	291,639	656,190	1,166,556
2,000	2,856	30	431 5	59.3	18,227	72,910	164,017	291,639
3,000	4,285	30	431.5	59.3	8,101	32,404	72,910	129,617

NOTE.—In estimating the efficiency of transmission from generator axle to motor axle the efficiency of the machines is taken as 92 per cent.
500 kw. is approximately equal to 670 h. p.

*Abstract of a paper read before the Technical Society of the Pacific Coast.

Discussion.—G. P. Low.—The members of this society may not be fully aware that in the United States the Pacific Coast has been foremost in transmitting electric power long distances. The first long-distance transmission in this country was that between Oregon City and Portland. There an alternating current is transmitted at a pressure of 4,000 volts thirteen miles. However, the power is used for lighting purposes only. Then came the power transmission plant at Telluride, Colo., which has been referred to by the speaker this evening. Following that came the plant at San Antonio, from which power for heating purposes is transmitted at 10,000 volts fifteen miles to Pomona, and thirty miles to San Bernardino. During the past month I have had the privilege of examining the details of this plant.

A most interesting installation is now under construction at Redlands. It is a triphase system to be used for both lighting and power. The operation of these two plants in Southern California is watched with great interest by the electrical world. But to eclipse them in magnitude is another installation about to be constructed for the transmission of 3,000 h. p. a distance of eighteen or twenty miles, and to which Mr. Hasson has referred.

In an installation of this kind many perplexing things arise that would completely nonplus a layman. In the San Antonio plant, for instance, conditions arise that will for a time baffle any electrical engineer.

I will not weary you with relating the several most interesting phenomena that came under my observation in examining the installation at Pomona. I will mention only one, which is known as the Ferranti effect.

Those who are conversant with hydraulics can readily realize if we have a pipe line with a head of water of 400 or 500 feet that the pressure at the foot of that pipe line is greater when the end is closed then when it is open; naturally you would expect that the moment the water commenced to flow through the pipe the pressure at the lower end would drop. This is erroneous when applied to the San Antonio plant. As stated by the speaker, the potential is 10,000 volts; the current is sent from the plant in San Antonio to San Bernardino, a distance of 29.7 miles. Naturally you would suppose that the potential at San Bernardino would be less than at the dynamo, just as the pressure drops in hydraulics. Instead, there is an increase of about 10 per cent., and in place of having, say, 9,000 volts on the line, they have 9,900 volts. (Mr. Hasson gave a solution of this and referred to Mr. Steinmetz's article in The Electrical World of April 29, 1893, for further details.)

A Curious Accident.

A correspondent in Havana, Cuba, sends us an interesting account of a recent accident to an overhead electric light conductor in Matanzas, as follows:

"Awhile ago the bridge crossing the San Juan River in Matanzas was carried away by a flood, which necessitated making a long span with the wires crossing the river. A few nights ago, just after starting up, there was a shower, and the report was sent in to the station that a wire was burning directly over the middle of the river. When the men arrived they found that one wire had burned off and both ends fallen into the water.

"At the station and in the part of the city lighted by that circuit no one noticed any change in the lighting, so it was left until morning, when the wires were taken out of the water and spliced, the current having passed through the water all night."

A somewhat similar case has been noted in which the burning was due to the wire having been held together by the insulation after parting until the latter was weakened by burning, the spark made at breaking igniting it. In the present case the section where the wire broke may have become reduced by corrosion or too great a strain, or there may have been a bad joint, the heat in either case setting fire to the insulation and, by consuming it, throwing all of the tension on the weak section or splice, thus breaking it. The continuation of the service in the manner described, through the ground and fallen ends, speaks well for the insulation of the system and of the electrician in charge.

International Electrical Congress at Chicago.

Prof. H. S. Carhart, Honorary Secretary of the Chicago World's Congress of Electricians, informs us that the following have promised to read papers at the Congress: W. H. Preece, F. R. S., Engineer-in-Chief of the General Post Office, London, subject, "Signaling Through Space by Means of Electro-Magnetic Vibrations"; Prof. W.E. Ayrton, F. R. S., City and Guilds of London Institute, Central Institution, subject, "The Variation of P. D. of the Electric Arc with Current, Thickness of Carbons and Distance Apart." Prof. Mascart, of Paris, will be present, but has been obliged to decline the preparation of a paper on account of other engagements. Prof. Ayrton sailed from London on June 21. Both the United States War and Navy departments have detailed officers to attend the Congress.

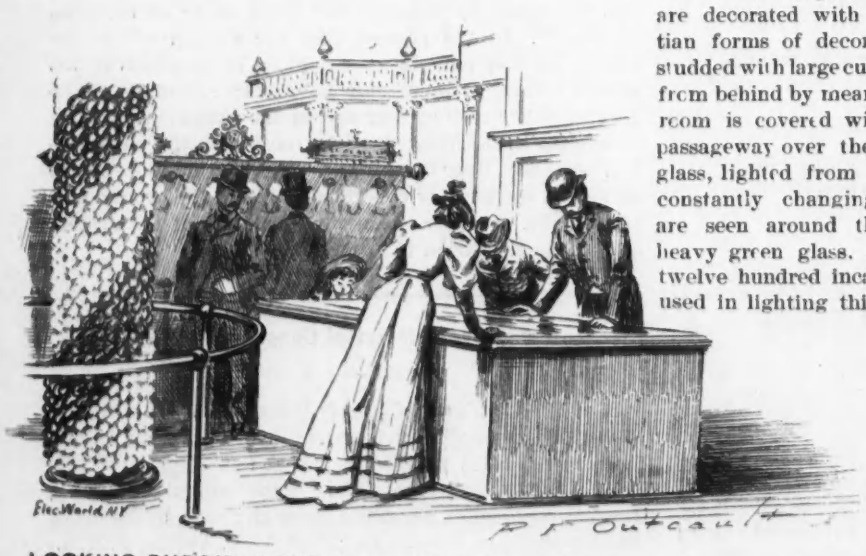
WESTERN ELECTRIC COMPANY AT THE WORLD'S FAIR

Elec World. N.Y. R. F. Outcault.

HOWEVER much we are inclined to pride ourselves upon living in an age of progress and great scientific accomplishment we must admit at times that the ancients have anticipated us. Each new archaeological discovery throws some new light upon the interesting past, and as the finding of the Rosetta stone in 1799, containing a decree of Ptolemy V. Epiphanes in hieroglyphics, demotic and Greek, supplied the key for the decipherment of the hieroglyphics of the ancient monuments of Egypt, so may the recent discovery of an Egyptian temple throw much light on the previous state of electrical development and set at rest many of the questions as regards priority of invention now occupying the attention of the courts.

Those eminent archaeologists, Messrs. Patterson and Tucker, of the Western Electric Company, have recently unearthed from the sands of the Nile a most remarkable relic of the past, covered with inscriptions and hieroglyphs, in an excellent state of preservation, indicating a date probably contemporaneous with the first dynasty. This is now on exhibition in the southeast corner of the Electricity Building at the World's Fair, and is justly attracting a great deal of attention. We do not understand whether the temple on view is the original one transported bodily from the burning sands of the Soudan or whether it is merely a fac-simile reproduction; but whatever it is, it is great.

While the Rosetta inscription gave the hint which opened a hitherto sealed book of ancient history, there has still remained a class of symbols that have thus far defied all attempts at elucidation. These are now explained for the first time. It needed but a hint to give the clue, and this has been furnished by the gentlemen mentioned. We propose in confidence to impart this hint to our readers so that they may interpret the inscriptions for themselves. If they will first examine the various implements and instruments made and exhibited by the Western Electric Company, and then examine the beautiful stencilings and glyphs on the exterior of the temple, they will at once be struck with the similarity of the two. There is no mistaking the incandescent lamp among these hitherto undeciphered inscriptions; thus even Heinrich Goebel must take a back seat. Arc lamps, too, with double carbons, are clearly delineated, relegating Charles F. Brush to his proper sphere. Alexander Graham Bell can no longer claim originality for his speaking telephone, as its use is clearly shown on the temple, and many other so-called inventions of the present day are shown in symbol or fac-simile. One looks in vain, however, for anything in the electric railway line, and the panic

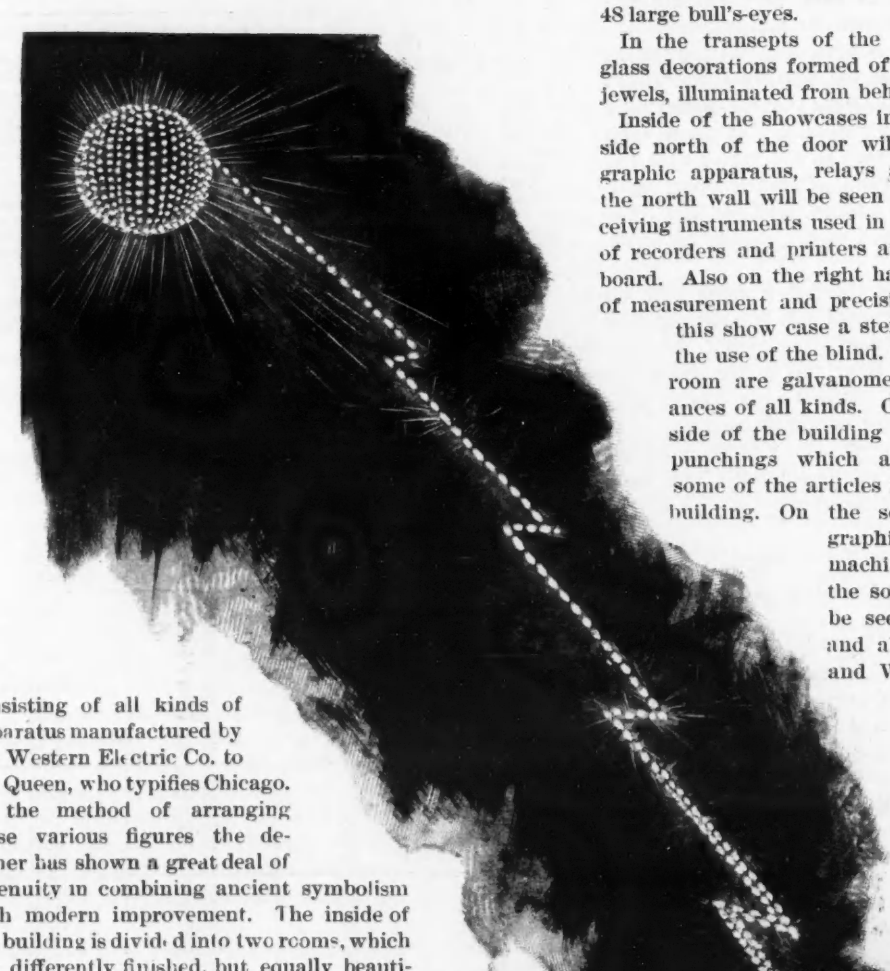


LOOKING THROUGH THE SCUTTLE AT THE LIGHTNING COMMUTATOR.

which this discovery has brought to others has not entered this field. Green and Adams and Bidwell and others still hold themselves in peace, however, but who knows when another Patterson or another Tucker may arise and unearth another mummy scarab with flexibly suspended motor or under-running trolley?

The exhibit of the Western Electric Company in the Electricity Building consists partly of displays of the apparatus which it manufactures, and partly of displays of decorative effects produced by electric lighting. Among the latter are the Egyptian Temple, the lighted column with the zigzag lightning and revolving balls, and the writing machines spelling the words Western Electric Company.

The Egyptian Temple is classically Egyptian in its style of architecture. The outside is beautifully decorated with Egyptian figures, represented as performing the work which is seen in operation in the Western Electric factory. In the frieze of the southeast side of the building is shown a police and telephone outfit, with the Egyptian patrol wagon hastening to the place from which the signal was sent; also fire-alarm apparatus, with the Egyptian fire engine going to the conflagration. On several parts of the building will be seen telephone switchboard and electric lighting apparatus, while on the north side will be seen Egyptians bearing presents



consisting of all kinds of apparatus manufactured by the Western Electric Co. to the Queen, who typifies Chicago. In the method of arranging these various figures the designer has shown a great deal of ingenuity in combining ancient symbolism with modern improvement. The inside of the building is divided into two rooms, which are differently finished, but equally beautiful. In the larger rooms the coves and sides are decorated with the lotus and other usual Egyptian forms of decoration, while the cove above is studded with large cut jewels of a rich ruby color, lighted from behind by means of incandescent lights. The smaller room is covered with a stained glass ceiling, while the passageway over the entrance has a ceiling of Murinese glass, lighted from behind by over 400 lights, which are constantly changing in color. The columns which are seen around the sides of the room are made of heavy green glass, and are lighted from within. Over twelve hundred incandescent lamps of 16 c. p. each are used in lighting this building, all so arranged that not one of them is visible. Recessed in the walls of both rooms will be seen showcases of instruments of various kinds manufactured by the Western Electric Co., mounted upon red plush. The floor is finished to represent stonework. The building is unique in every detail, both as to its decoration and its lighting. Over the doors are the typical Egyptian eagles and hooded serpents made out of cut glass, illuminated from behind by arc and incandescent lamps in such a manner as to bring out the most beautiful effects.

Returning again to the mural decorations, on the southwest side is shown a cable press, and the method of manufacturing lead covered cables.

There is an Egyptian coming out of a booth, which is placed over a manhole in the streets while laying the cable. Over him is an Egyptian unrolling a cable. Still farther up are Egyptians with pipe-tongs and soldering pots, and an Egyptian dipping a reel of wire into an insulating bath. Over that is an Egyptian who is testing a reel of cable for a broken wire, and higher up is an Egyptian with a galvanometer. On the top frieze is an Egyptian drawing a cable into a manhole in the street.

The presents which the Egyptians are bearing to the Queen consist of magneto bells, arc and incandescent lamps, annunciators, dynamos, motors, reels of silk and cotton covered annunciator wire, batteries, etc., all manufactured by the Western Electric Co.

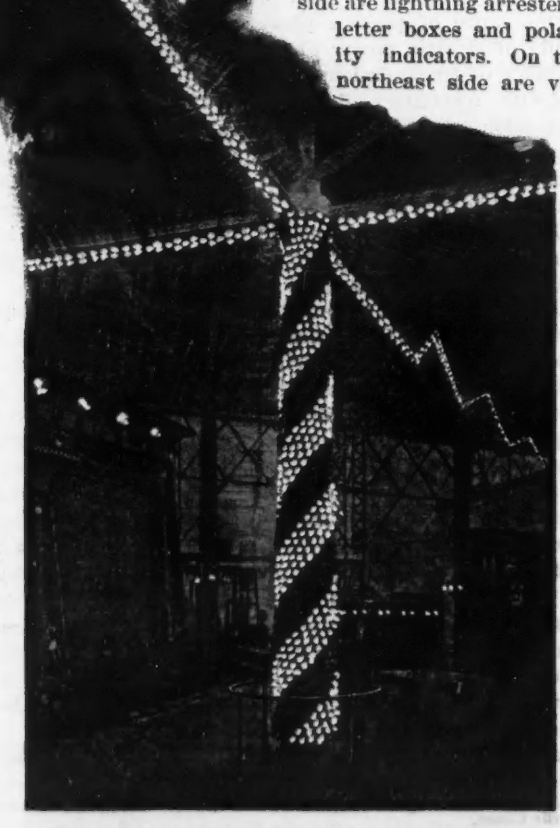
The building is tinted on the outside with a warm rose color, while the frieze is old gold. The stencilwork on the outside of the building is beautifully designed in typical Egyptian forms of decoration.

The cove on the outside of the building is lighted by 48 large bull's-eyes.

In the transepts of the entrances there are stained glass decorations formed of lotus blossoms and cut-glass jewels, illuminated from behind by incandescent lamps.

Inside of the showcases in the large room on the west side north of the door will be seen all kinds of telegraphic apparatus, relays and switchboards; while on the north wall will be seen in the left hand case the receiving instruments used in telegraph stations, consisting of recorders and printers and a large telegraph switchboard. Also on the right hand will be seen instruments of measurement and precision. There is also shown in this show case a stenographic machine made for the use of the blind. On the east side of the large room are galvanometers with slides and resistances of all kinds. On the east side of the south side of the building is a case with some of the punchings which are used in manufacturing some of the articles shown in the interior of this building. On the south side are shown telegraphic apparatus and a printing machine for telegraphic use. On the southwest and west sides will be seen meters and voltmeters, and also some district call boxes and Wheatstone bridges. Around the doorways is a stencilwork studding of electric patterns of different kinds intermingled with Egyptian forms and figures.

In the small room on the northwest side are samples of push keys in wood and bronze. While on the north side are lightning arresters, letter boxes and polarity indicators. On the northeast side are va-



THE LIGHTNING TOWER AND GLOBE.

rious kinds of electric bells, turtle gongs and speaking tube elbows.

On the south wall are various kinds of letter boxes with push attachments. This room is well ventilated with two radiators, through which a blast of fresh air is kept in constant circulation.

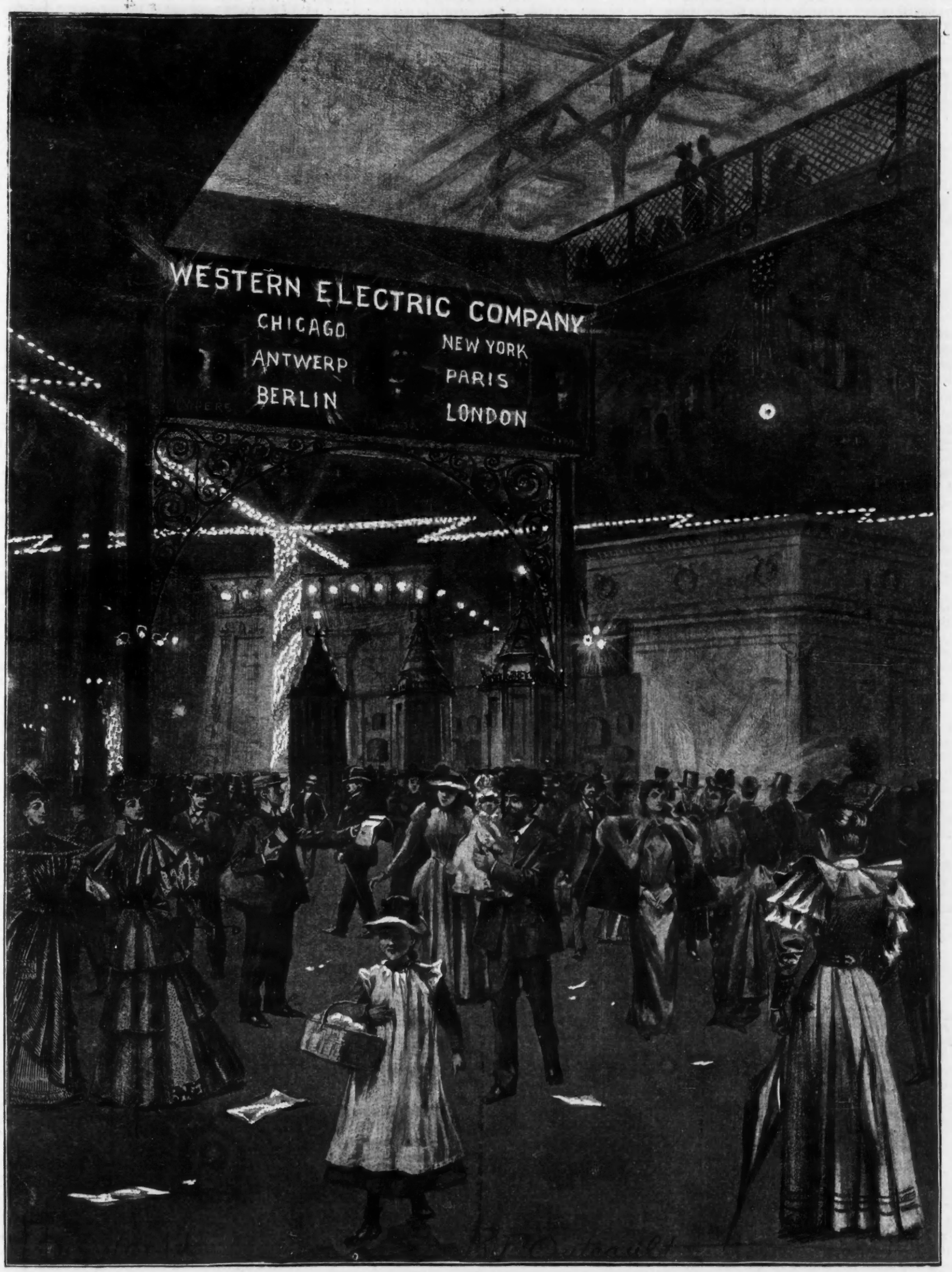
Healy & Millett made the decorations on the temple, they being carried out from the ideas suggested by Mr. Patterson.

An interesting historical exhibit, located just outside the temple, shows what has been done in the pioneer line by the late Moses Gerrish Farmer. Among other things will be seen a street-car motor and trailer, which were made by Mr. Farmer in 1847. This is a reproduction of the original, and made from descriptions and suggestions furnished by Mr. Farmer before his death. One of the seats and a pair of the wheels, however, are the originals used in 1847. The motor is supposed to be the first reversible motor ever constructed. The principle shown in connection with the control of the current illustrates how closely Mr. Farmer was working upon the principles of to-day. On the side of the car will be seen a diagram giving the connections for forward and backward movement. On the column back of the engine is hung a handbill, which was printed in 1847, advertising the exhibit of this electro-magnetic engine to the public for the first time.

A small motor, made very early by Mr. Farmer, embodying the electro-dynamic principle, claimed to have been the first ever made embodying this principle, would seem to settle beyond peradventure that this great discovery belongs to America.

Upon an old mantelpiece, taken from the parlor of Mr. Farmer's home at Salem, Mass., will be seen two incandescent lamps, reproduced from descriptions given by Mr. Farmer of lamps which he made and burned in 1859. These lamps consist of a filament of platinum wire placed in a glass tube, and from measurements given by Mr. Farmer are found to be 32 c. p. each.

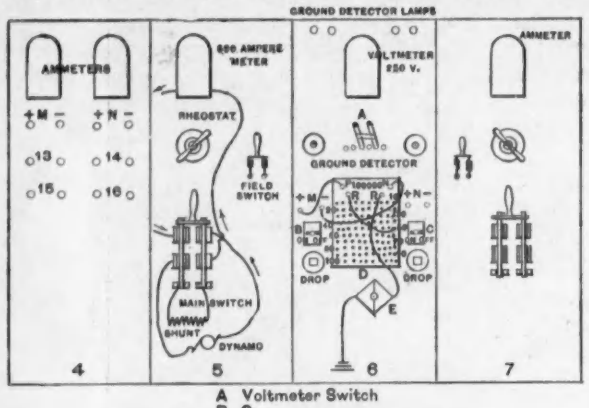
At the north end of the Western Electric Company's exhibit is a large illuminated sign made of iron and plate glass and flashed glass. The letters are made of two plates of glass filled in with fragments of flashed glass of different colors. Behind the letters are 14 arc



A VIEW IN THE WESTERN ELECTRIC COMPANY'S EXHIBIT AT THE WORLD'S FAIR.

lamps, which are kept in motion by a small motor, producing a scintillating effect resembling diamonds, rubies, sapphires and emeralds. On this sign are placed portraits of six historical electricians, viz., Franklin, Henry and Volta on one side and Faraday, Ohm and Ampere on the other.

Southeast of the temple are arranged a number of arc and incandescent machines of all sizes, and samples of single and double carbon arc lamps. Also Kruger lamps are shown, arranged with olivet hood, lens, and reflector. These lamps are for stage use in theatres, and



A Voltmeter Switch
B C
D Rudd's Ground Detector
E Wheatstone Bridge

Fig. 1.

by means of them light can be concentrated upon moving forms. These lamps will burn in any position from the vertical to the horizontal, and are made to use on arc and incandescent circuits.

THE GENERATING PLANT AND SWITCHBOARD.

In previous articles we have stated that the electrical generating plants of the Columbian Exposition are all located along the south side of Machinery Hall, extending westward into the Annex. The generating plant of the Western Electric Company occupies the extreme western block of the space assigned to electrical generating apparatus, and is located not far from the centre of the Annex.

This exhibit may for our purposes be divided into two distinct parts. It will be remembered that each of the more prominent companies was asked to furnish current for a portion of the arc lighting of the buildings and the grounds. That portion devoted to this purpose may be called the Exposition exhibit and occupies the north half of their space, and the remainder which supplies current to their own exhibit in Electricity Building may be appropriately called their own.

Beginning at the extreme south there will be found a 100-h. p. Russell engine, 13 × 18 inches, running at 250 revolutions. This has two large pulleys, each 6 feet in diameter, from which two 50-light arc machines are driven by 10-inch belts, furnished by the Graton & Knight Mfg. Co., of Worcester, Mass. Directly north of this engine are two other Russell engines with cylinders 17 × 24 inches, which at 158 revolutions develop 200 h. p. each.

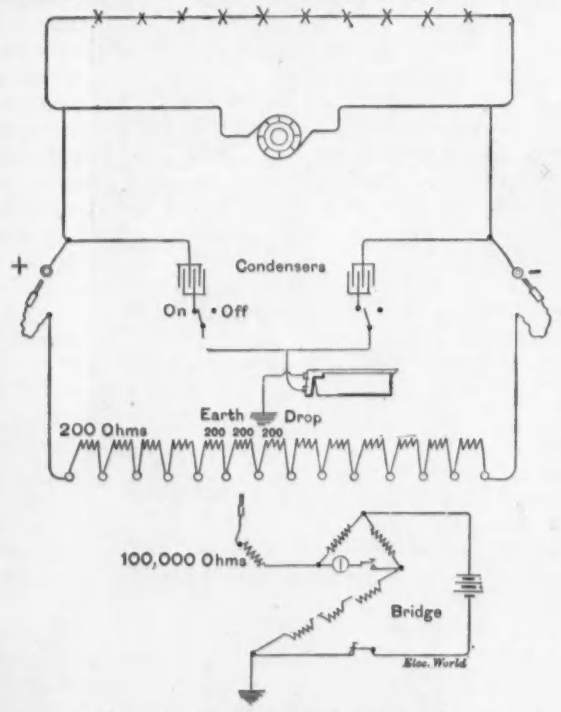


Fig. 2.—Budd's Ground Alarm.

These are belted to two multipolar (6 pole) generators, which supply current for their own display in Electricity Building as well as for the American Bell Telephone Temple at 250 volts. The full load for each of these generators is 550 amperes. Belting of the same manufacture, 20 inches wide, transmits the power from these engines to their dynamos.

The above generates all the current required for their own display.

Next we come to a 150-h. p. N. Y. Safety engine, with two flywheels, from one of which two 50-light arc machines are driven in tandem, and a single machine is driven from the other.

Still farther to the north is another 150-h. p. engine. This has an automatic cut-off and also has two flywheels, from which are driven in like manner three 50-light arc machines—two in tandem and one single. The cylinder of this engine is 15 × 14 inches, and its speed 275 revolutions. It was furnished by the Erie City Iron Works.

Next, and on the main aisle, is a 250-h. p. compound condensing engine made by the Watertown (N. Y.) Steam Engine Company. Its cylinders are 9 inches and 16 inches and its stroke 14 inches. A peculiarity of this engine is that it has three flywheels, from which it drives four 50-light arc machines—two being driven in tandem from the central pulley. The belts used on these last three engines are all 10-inch perforated belts of the Charles A. Schieren make.

These 10 generators supply current mostly to the Transportation Building and complete what has been termed the Exposition plant.

The currents from all these machines go to a single switchboard facing the transverse aisle to the west. This is composed of seven handsome slabs of Tennessee marble, polished on both sides, and divided, like the floor space assigned to this company, into two parts—the three northern slabs being devoted exclusively to the apparatus controlling the arc light circuits used for Exposition purposes, and the four to the south of these to their own circuits.

We have seen that they have installed for their own use two 50-light arc machines. The middle panel shown on the left in Fig. 1 is devoted to these two machines, which are designated by the letters M and N and their two circuits 13, 14.

There are also plugs for two more circuits, Nos. 15 and 16, but these are not in commission yet.

Panel No. 5 is devoted exclusively to the control of the current from one of the large multipolar incandescent machines. These machines were originally intended for compound machines, and the small switch marked "field switch" was intended for the control of the shunt winding. It was decided to operate them as shunt machines, however, so the shunt coils were connected across the base of the main switch, as shown in diagram in panel 5. The course of the main circuit is also outlined. A feature of this switch not shown is that the jaws are so proportioned that, in the act of closing, the knife-edges take first into the right hand lower jaw, then into the left hand lower one, and finally into the right and left hand upper jaws. This sequence is reversed on opening. In this way it is seen the shunt circuit is completed first on closing and broken last on opening the circuits.

Panel No. 6 is the most interesting on this switchboard, and while devoted exclusively to the control of the Western Electric Company's own currents it is connected with both the incandescent and arc light circuits. Beginning at the top are the ground detector lamps for the incandescent circuit. There are four of these in series, a red and a blue on each side, connected across the 250-volt circuit. When there is no ground, the current that passes is only sufficient to bring them to dull redness. By pressing either the right or the left hand push button, however, two of them come to full candle power in case there is a ground, and indicate also on which side of the circuit the ground is.

The voltmeter is of the usual type, but the switch A beneath it is of especial interest, as by turning it to the right it causes the voltmeter to register the pressure at the dynamo terminals, while, by turning it to the left it causes it to register the pressure at the centre of distribution—in this case, the southeast corner of Electricity Building. Thus far the panel is devoted to the incandescent circuits.

Below this is located the ground detecting apparatus for the arc light circuits. That employed here is known as Rudd's ground alarm, and consists of a resistance board, on either side of which are the terminals of one of the two generators, M, N, in service; a condenser switch, B C, and a drop. Immediately below, on a small shelf, is an ordinary Wheatstone bridge, and on the floor beneath this is the battery for same. At the top of the resistance board are two plugs, P and N, which, in testing, are connected by flexible conductors to the positive and negative terminals of the machine, as shown. There are also two other plugs marked R, R, between which there is a fixed resistance of 100,000 ohms. This is in series with the Wheatstone bridge to prevent too great current from passing through when testing a live circuit.

The resistance board has 100 plugholes in its face, between each two of which there is a resistance of 200 ohms. These are numbered from left to right and right to left on alternate rows, there being 10 rows in all. In addition, there is one extra plug a little above the first row marked 0; thus the plughole marked 50, which is the left hand hole in the fifth row, has 50 resistances of 200 ohms each on either side of it.

The condenser switches to the left and right of the board are for the purpose of throwing off or on the two condensers on the back of the panel, shown in Fig. 2.

Below the condenser switches are shutters which drop when there is a ground on the circuit, and directly below the resistance board is a Wheatstone bridge, one side of which is grounded and the other side of which goes to the resistance board, as will be shown.

If a ground is indicated by the dropping of a shutter, and it is desired to measure the resistance of that ground, the condenser switch is first turned off and then the terminals of the circuit are plugged into the corresponding terminals of the board. The bridge battery is turned off and one bridge terminal is connected to the right hand end of the permanent resistance, and the left hand end is plugged into resistance plug No. 50 on the board. The current, before it can get to the

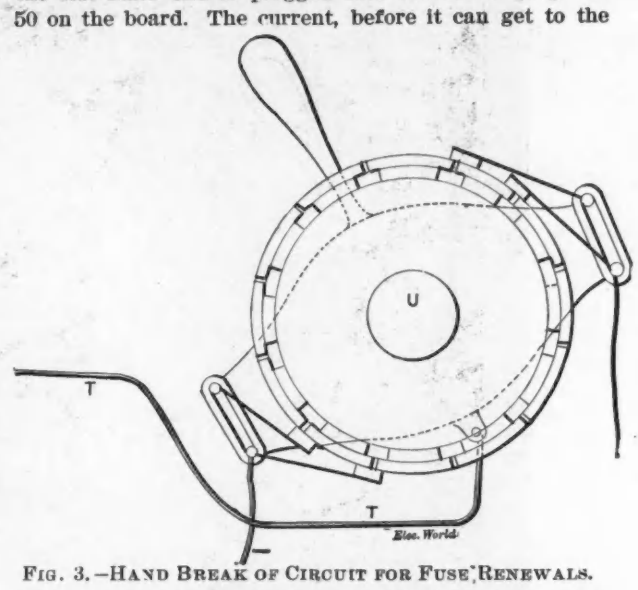


Fig. 3.—Hand Break of Circuit for Fuse Renewals.

bridge, must have passed through the permanent resistance of 100,000 ohms, and therefore can do no harm, whatever the electro motive force. On grounding the other terminal of the bridge, the galvanometer needle will be found to deviate, and the direction of this deviation indicates on which side of the circuit the ground is. The bridge is now balanced by withdrawing the plug from No. 50 and cutting in or out the necessary number of resistance coils by inserting it in one of the holes below or above the 50 line. When the bridge is thus balanced, the circuit, though in full operation, may be treated like a dead circuit, and the resistance of the ground is found by inserting the bridge battery and again balancing the bridge by means of its own set of resistance coils. The true resistance of the ground is found by subtracting from the bridge resistance the permanent resistance (100,000 ohms) and that required on the board to balance the bridge. In this way the insulation resistance of the line may be obtained at any time without interference with its operation. Should the line be out of commission, instead of plugging in the permanent resistance R R the bridge is plugged directly into the extra plug hole marked zero, above referred to, the bridge battery is at once thrown in, and the balancing of the bridge alone gives the resistance directly.

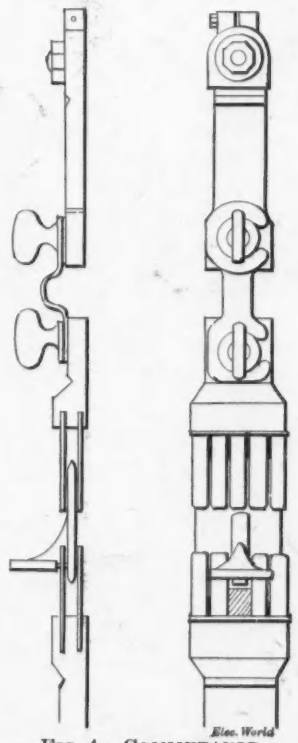


Fig. 4.—Commutator, Brushes and Rocker.

The seventh panel is a duplicate of the fifth, the relative positions of the field switch and rheostat handle being reversed, however.

On the rear end of the board are the terminals of the arc light circuits, the bus bars and other connections and rheostats of the incandescent circuits, and the condensers for the Rudd ground conductor. It may be well to mention here that usually where this latter device is employed the dropping of the shutter closes a local bell circuit and an audible, as well as visual, signal is given, but in the present installation the bell circuit has been omitted.

Quite a neat little device is introduced into the incandescent light switchboards exhibited by this company to enable a fuse that has been blown to be replaced without subjecting the operator to the danger of a shock. Between the fuse and bus bar there is inserted into the conductor a sliding piece which, when pulled up, bridges a short break, electrical contact being insured at both ends of this piece by spring clamps or brushes between which the piece slides. When a fuse has been blown and another has been inserted, the sliding piece is first pushed down into the lower conductor until its contact with the upper conductor is broken. The fuse may then be introduced into its proper place with impunity by reason of the break below. The sliding piece is then pulled up into its original position and the circuit is closed.

On the right hand of the switchboard is a handsome bronzed standard, supporting a pretty red lantern which is illuminated at night by three incandescent lamps. This lantern advertises the fact that the belting used was furnished by Graton & Knight, while on the left is a bronzed cord rack, upon which are hung the

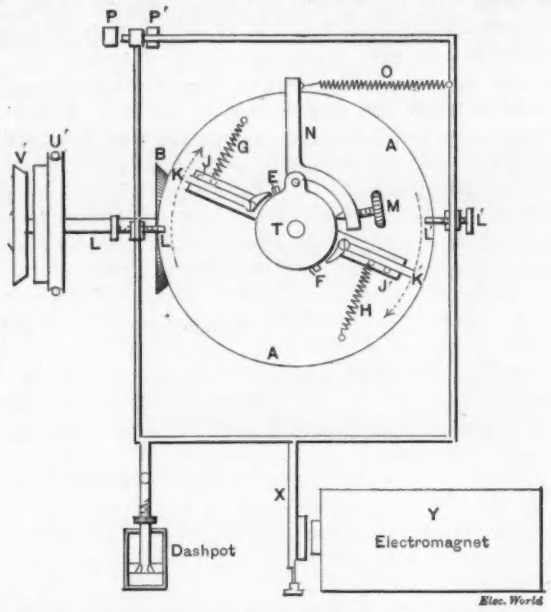


FIG. 5.—ELEVATION OF ARC CONTROLLING DEVICE.

arc light connecting cords when not in use on the board, the two making quite a pretty setting for the simple switchboard just described.

From the switchboard the various conductors descend beneath the floor of the building and are carried thence through underground conduits to the Electricity Building, where we will find them appearing again on the main switchboard in the company's exhibit there.

For the constant potential currents there are 12 0000 conductors, and for the arc light currents there are four No. 6 conductors.

THE ARC LIGHT CURRENT CONTROLLER.

Before proceeding to the Electricity Building to see how these currents are utilized it may be well to spend a few moments in studying the method employed by this company for maintaining a constant current on their arc light dynamos. As every one is aware, the arc light generators of the Western Electric Company have fields of the consequent pole type. There are, therefore, four field coils. On the armature there are 12 coils, each being brought out to a commutator bar of its own. There are four brushes connected, two and two, to the opposite ends of the rocker, as shown in Fig. 4.

As is there shown, the two brushes on a side span a space between centres somewhat less than the width of a commutator segment, but in their outside span something greater, and so situated relatively to each other that, as one brush is just about leaving a commutator bar—that is, while the major portion of it has already passed over the following segment—the other brush is just entering the second bar ahead.

The rocker, or quadrant as it is called here, is automatically shifted, as the requirements of the circuit demand, by the rod T (Figs. 4, 5 and 6), which is given a longitudinal motion either to the right or left, as one or the other of two dogs engaged in their appropriate catches, as will be explained further on.

Fig. 5 is an elevation and Fig. 6 a plan showing diagrammatically the method of automatic current control. In Fig. 5, Y is an electromagnet in series with the circuit, and X is a light metallic frame hinged at the bottom. O is a spring the tension of which is regulated by the

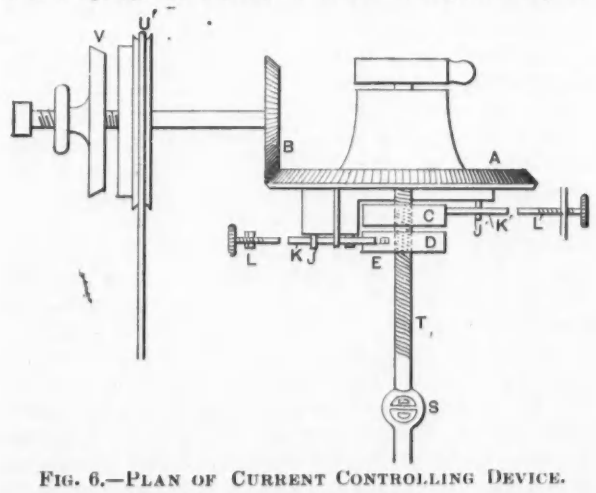


FIG. 6.—PLAN OF CURRENT CONTROLLING DEVICE.

set screw M through the bent lever N. The electromagnet, in its attraction for the armature on the leg of this frame, works against the tension of the coiled spring O.

A A is a beveled wheel driven by the pioion B (Figs. 5 and 6) from the pulley U (Fig. 4), belted to pulley u'.

Upon the shaft T, which is cut with a thread and passes through A, are placed two small cylinders, C and D, which revolve with the shaft. C is keyed to the shaft, but D is threaded. Upon both C and D are placed pins, E and F, against which the bent levers or dogs, K and K', catch, causing that pulley to revolve with A as long as its dog is engaged with the pin. In the sides of the frame X (Fig. 5) are two adjustable stops, L, L', extending inwardly some distance, but not far enough to engage the outer arm of either dog when the frame is perfectly central, but so that if the magnet and the spring O get slightly out of balance either K or K' will be tripped by L or L' as they pass, releasing the dogs from their catches and permitting their respective cylinders to stand still. Thus it is a case of a screw and a nut. If both are revolved at the same speed, as is the case where both dogs are engaged, there is no progressive motion of the screw. If the nut is held stationary and the screw revolves there will be a progressive motion of the screw in one direction, and if the nut is revolved and the screw has no rotary motion the latter will be moved longitudinally in the opposite direction. Thus it will be apparent how, by the continued rotation of the disc A, the rod T may be given a motion of translation either in one or the other longitudinal direction according to which dog is released, or remain stationary as far as longitudinal direction is concerned when neither is released or both are. If the movement of the brushes by this single longitudinal motion is not sufficient to restore the balance between O and the magnet, the appropriate dog will be again released and a further shifting be accomplished; but because of there being two dogs diametrically opposite, one or the other of which is liable to be released every half revolution, the longitudinal motion of the rod T can only take place in either direction through one-half a revolution and will be nil through the other half. The motion, however, will be repeated with these intervals until sufficient change has been made in the position of the brushes to bring the spring O and the magnet into equilibrium, and then it will stop until the two get out of balance again, because of too much or too little current.

To prevent the position of the frame from being changed by the rapid accidental fluctuations of the current, its motion is damped by a dashpot connected to one of its lower corners, as shown, and the dampening effect may be increased or decreased within limits at will by

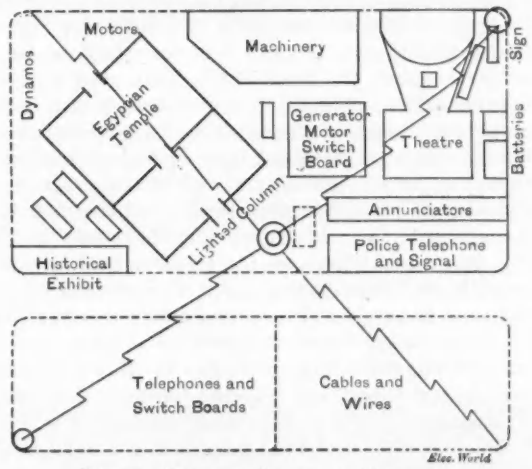


FIG. 7.—GROUND PLAN OF EXHIBIT.

quite an ingenious arrangement. The oil in the dashpot finds its way from one side to the other of the piston through a number of perforations extending from the lower side up through the sleeve extending from its upper side. Through these passages all the oil must flow. This sleeve is threaded within, and screws onto the connecting rod which extends down into the piston head proper. As it is screwed farther on or unscrewed, the passageways for the oil are opened or closed; thus by the simple manipulation of turning the milled head in one direction or the other, greater or less damping effect is secured.

Still another ingenious device contributing to the convenience of handling this mechanism is shown to the left of Figs. 5 and 6. U', the pulley, is attached to its shaft by means of the cone friction clutch V, which is screwed to the same. The pulley normally runs loose, and the controlling mechanism is then inoperative, but is readily thrown into action by screwing V home until it binds in its seat. To throw it out of action again it is only necessary to unscrew it, which is conveniently done by a single blow of the hand on the milled head to the left.

Leaving now the exhibit in Machinery Hall, we go to the other more elaborate one in the Electricity Building. This latter will be found covering an extensive area near the southeast corner, just opposite the temple of the American Bell Telephone Company. Reference to the plan of the display (Fig. 7) will give an idea at once of the relative positions of the various departments.

The various circuits which we traced out through the switchboard in Machinery Hall come to another switchboard in this display, where we will now take them up again. It is the usual custom in electrical stations to present but one side of the switchboard to view. However handsome that may be, attempts at finish for the reverse side are entirely neglected. The two views may be likened to those obtained of a stage setting from in front of the footlights and from the rear. While the former is fair to see, it has been compared to a whited sepulchre—all foulness and rottenness within.

The Western Electric Company have made a departure from the usual custom in this case, and while there was ample opportunity of so stationing this switchboard as to conceal its reverse side, they have boldly placed it so that both sides are equally conspicuous, and have shown how the reverse may be made equally attractive with the front. We regard this as a distinct advance in switchboard construction, for in these days of aesthetic development it is not enough that a thing should be useful; we are too utilitarian still to believe it sufficient that it be beautiful; but the highest advances of our civilization demand that it should be both beautiful and useful.

Both the French and the German, and, to a less extent, the English, have far surpassed us in the combination of these two features, and the tasteful arrangement of the displays at Frankfort were much commented on by visitors. Those from this country noted a higher finish in the goods, a better taste pervading everything they

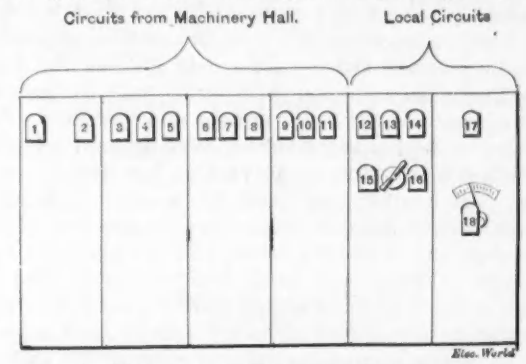


FIG. 8.—KEY TO THE FRONT OF SWITCHBOARD.

saw there, than they had seen at previous expositions, and there were those who suggested that our own exhibitors at the present Exposition might study those displays with profit to themselves. Whether or not the Western Electric Company took the Frankfort or the Crystal Palace exhibitions as their models we do not know, but certain it is that throughout their display is marked by the utmost good taste and refinement of feeling. Nowhere is this more prominent, with perhaps one exception, than in the switchboard about to be described.

THE SWITCHBOARD.

This is composed of six slabs of Tennessee marble highly polished on both sides and richly mounted in bronzed copper. Over the centre, supported in bronze scrollwork, is placed a small clock, and on either side, in old English text, are, to the south or left hand side as one faces the board, the words "Western Electric Company," and to the north or right, "Chicago, New York."

All of the fittings are in polished brass and hard rubber, in beautiful contrast to the rich color of the marble behind. In addition to the handsome cut which we produce, we also give, for the purpose of better tracing out the circuits here controlled, a key to the same, with at least one significant instrument numbered for the purpose of reference.

The first slab contains at its top two ammeters which are in the two arc-light circuits before referred to, and below are located the plugholes by which these circuits are connected to those which lead to the various parts of the display. No. 3 goes to the Egyptian Temple. No. 4 is in a circuit which supplies current to 400 lamps in various other parts of the exhibit, to the lanterns, etc. No. 5 measures the current supplied to the American Bell Company's exhibit, 460 lights in all. Thus far all of the incandescent currents are at 220 volts or thereabouts, and the lamps supplied therefrom are 110-volt lamps arranged two in series. But it was desired to illustrate the principle of transformation of continuous currents, and for this purpose a 220-volt motor was installed just to the west of the switchboard, and this was connected directly to a 110-volt generator from which current is supplied to the lamps on the column, the streamers, revolving globes, etc. No. 6 controls the current operating this 220-volt motor. No. 7 runs a 10-h. p. motor in the basement which drives a large fan used to ventilate the temple and theatre. No. 8 furnishes current for a 25-h. p. motor which drives the machinery which they exhibit in motion. Circuit No. 9 supplies current for commercial purposes, for which purpose the company has connected 140 lamps. No. 10 is blank. No. 11 operates the two writing machines, to be further described.

The instruments in the next panel are employed exclusively for the transformed currents as follows: To No.

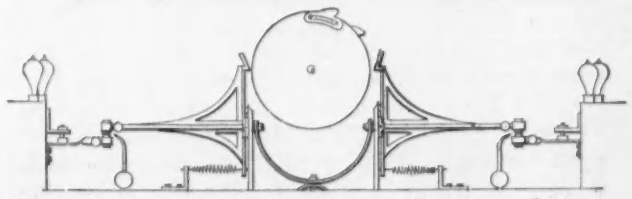


FIG. 9.—SECTION ACROSS COMMUTATOR DRUM FOR LIGHT CONTROL ON TOWER.

12 are connected 400 intermittent lamps employed to illuminate with varying colors the ceiling of the east room of the temple. No. 13 controls the 2,632 lamps in the column streamers and globes. Just beneath this is a push button for signaling to their generating station in Machinery Hall.

The American Bell Telephone Co. employ storage batteries for their exchange work, and the charging currents for these pass through No. 14. The main ampere meter is indicated by No. 15, and between Nos. 14 and 15 is

located the rheostat. No. 16 is the volt meter for the 110-volt circuits. No. 17 is another voltmeter indicating the pressure of the 220-volt circuits at the brushes in Machinery Hall. No. 18 is the Western Electric Company's new automatic field brake, and is connected in the 220-volt circuit which operates the 220-volt motor before referred to. This is an exceedingly valuable instrument for the purpose. On the reverse side of the slab is a large rheostat, and the instrument is so constructed that if by any means the motor has been cut out of circuit it cannot be started again without first throwing in the resistances of the rheostat. In this way the damage resulting from too rapidly turning on the current to a motor at rest is avoided.

The reverse side of the board, while scarcely less handsome, is certainly more interesting than the front, for here are shown in full view the various connections. On the extreme right, as we now look at the board, are the arc light circuits. Coming up from the basement at the centre of the board are the other circuits. These are led to the top through handsome bronzed tubes and these are distributed to the various instruments on the face. The bus bars and most of the other connections are of highly polished brass, and to the left are the two rhostats before referred to, unboxed and open to inspection. Considerable space just back of the board is inclosed by a bronzed railing which serves the double purpose of keeping venturesome visitors from attempting unhealthy electro-theraputical experiments and outlining a space for the attendant. Within this space is located, besides the motor generator, an office desk and other furniture for the use of the switchboard attendant.

THE MACHINERY.

Directly west of this space and fronting on the aisle which separates the Western Electric Company's display from that of the American Bell Telephone Company are displayed a number of ingenious machines required for the manufacture of the wares of the company. These are in actual operation and are driven all from shafting by a 10-h. p. four-pole motor. In addition to the machinery above referred to, this motor also drives a 50-ampere six-volt generator used to charge the storage batteries in the Bell Telephone Company's exhibit. Commencing at the north end of the machinery, or rather the industrial exhibit, the first machine we come to is an automatic nut machine. On one side the brass is fed in the form of a ribbon, and at the other is delivered the finished nut, hexagonal in shape, with a screw thread cut in it and the name of the company stamped on its face. These are the smaller sized nuts used largely on apparatus and are three-eighths inch in diameter. This machine can turn out 5,000 of these nuts without further manual assistance than the feeding to it of new ribbons as fast as the old ones are chewed up.

Next comes a multiple drill process with its 24 spindles and odd little ball joints by which the drills may be adjusted to various patterns in rubber, wood or metal work. Adjoining this is an automatic screw machine, which, like the nut machine, feeds on brass rods and turns out finished screws threaded, milled and stamped with the company's name. This is even more interesting than the nut machine, as it seems almost endowed with human intelligence. One-half of the screw is finished before it is cut from the rod. At this point in the operation a tool descends and grasps and holds it by the finished end while another tool descends and cuts it off. The first tool then raises the half finished screw, reverses it and inserts it into another chuck which brings it into position for still another tool to put on the finishing touches. All this is done in about a minute's time. Larger machines than this are in use at the factory which can turn out in the neighborhood of 7,000 per day.

South of this is a machine engaged in insulating wires for telegraph purposes with silk. This has 10 spindles. Another one, wrapping wire with two layers of paper insulation for underground cables, adjoins it. Annunciator wire is also wound by a third machine, and next to this is a machine making at one operation the strand conductor, braided insulation and spirally wound wire covering of small flexible conductors.

At the extreme south of this space is a stranding machine whose ingeniously manipulated spools toss into the air like the implements of a skilled juggler. Over and over they go, seemingly from one hand to the other, spool following spool in such rapid succession as to convey the idea of a dozen instead of the three that there are; but with never a mistake they continue. This display would make a Japanese juggler green with envy, as it casts his performance far into the shade, and, what is better, it accomplishes a useful purpose, too, for there results a faultlessly stranded conductor such as the most skillful human hand could not improve upon.

In the rear of the machines thus described is still another, more remarkable, if anything, than any of those yet seen. This is a braiding machine, and its work is different from that of the other. The former twists together the strands of small flexible conductors. The latter braids, with three layers of silk, insulation upon the conductors. To this the bare wire is fed at the bottom, and in its progress upward passes through three separate planes of existence, as the Buddhists would say, on each of which play 16 spools in a grand right and left, crossing and recrossing each other's paths until it makes one dizzy to watch them. But not so the spools; on and on they go about their business, too much in a hurry to bow as they pass by, but too polite even in their game of hide and seek to interfere the one with the others in what seems a mad rush to accomplish something which the spectator cannot discern. But as the wire emerges from each of these different planes it does so clad in a new and perfect garment, until when it has passed the third it is considered fully dressed, and is unceremoniously wound upon a reel to be stored away for future use. While these machines are only electrical in so far as they are driven by an electric motor and their products find wide application in the electrical industry, they are a most valuable object lesson to the multitudes who pause to watch them from hour to hour, only to return again at the next opportunity to learn their lesson over again.

But there are still other displays of interest in this department. Right adjoining the last-named machine is a table upon which the tinsel for the flexible conductors before referred to is bunched from reels, and these bunches wound upon spools preparatory to the stranding process. The paper tape which is employed for the paper insulation before referred is also here wound on spools. It must be remembered that air is a much better insulation than even paper, and, when telephone wires are insulated dry, the paper really plays but a secondary role in the insulation, namely, to provide a vehicle for as much air between the wires as possible. To accomplish this it must not lie flat—in fact, it is desirable to have a minimum amount of paper occupy as much space as possible, for thereby a cable with a maximum insulation resistance is obtained with a minimum static capacity. In preparation for this, the paper strip as it passes from the reel to the spool passes through a perforating machine which deeply grooves and perforates a channel down its centre, and thus prepared and wound on spools it is ready to apply to telephone cables and others not intended for subaqueous use.

On another table the operation of winding the magneto bobbins used to ring the call bells on telephone lines is exhibited. These are wound on a lathe, and the young girl who does this work becomes exceedingly skillful through long practice. There are two bobbins on each magneto, and it is desirable that each shall contain exactly the same amount of wire. So it is measured—not with the yard stick, but electrically, and the ohm is the unit employed. On each bobbin there is wound 250 ohms of No. 35 copper wire, and the measurement is quickly done with the Wheatstone bridge. The winding of about 36 bobbins is considered a good day's work, but this is often exceeded by skilled operators.

Another ingenious machine used by this company is one to coil rheostat wire. Heretofore this has usually been done on a mandrel, and when one length was filled the mandrel was removed and another length wound, and so on. The present machine will coil a rheostat wire as long as the wire itself can be made and at one operation. It consists simply of a very short mandrel, surrounding which is a spiral groove into which the straight wire is fed and from which it is delivered in spiral form of any desired length. A sample of such a spiral 200 feet long may be seen strung around through a portion of their space on the east side.

TELEPHONE AND SWITCHBOARD APPARATUS.

In the eastern portion of this company's space, and directly under one of the four streaks of lightning, is grouped together the largest and most complete exhibit of telephone apparatus ever shown to the public. There are magnet bells of every type. The telephone man easily identifies the No. 1, No. 2 and No. 3 Chicago magnetos, as well as the now much used 1,000-ohm bridging bell. Besides these are bells of special design, such as are designed for either a direct or alternating current; a bell with two sets of ringers for use with private lines; bells with push-button cut-outs as well as with automatic. There is also a magneto bell on the "nickle-in-the-slot" principle, designed for self-collecting toll work. The Antwerp branch of the Western Electric Company has made a large contribution to this exhibit, and a comparison of the foreign and domestic instruments is an interesting study.

One noticeable feature of the foreign made instruments is that they are provided with two receivers, one usually being of the bi-polar style and the other a "pony" or pony crown receiver.

Two telephone sets, complete with transmitter and telephone—one of them made in the Chicago and New York factories, the other in the Antwerp factory—lie on the counter side by side, arranged as are all their instruments, so that the lids can be thrown open and an examination made. The comparison shows a decided difference in the methods of making the apparatus, and while the domestic instrument is not finished so well as the foreign the mechanism of the magneto generators shows a decided difference in favor of the American apparatus. One foreign-made instrument shown, viz., a desk set, is very convenient. In a compact and beautifully finished box there is a generator and bell, while an arm carries a Hunning transmitter; two receivers are provided; the whole arrangement can be moved about the desk as desired.

A showcase near the instruments contains a complete telephone set in parts. There is the magneto and bell, with its 330 parts spread out, the Blake transmitter with 88 parts, and the telephone proper with 28 parts. The would-be competitor of the American Bell Telephone Company can here study the parts of instruments, although the complete dissection may possibly prevent his learning much. In this portion of the exhibit are two instruments which have an historic interest, being Gray's automatic printers, the invention of Elisha Gray. This form of instrument had an extensive use before the days of the telephone. The two samples are among the few existing, and they are connected up in working order, ready to send and receive the printed messages.

A Hollerith tabulating machine, as used in the United States census work, occupies a place near these instruments.

A showcase filled with all kinds of telephones and transmitters made by the Western Electric Company for the American Bell Telephone Company completes the strictly telephone portion of the exhibit.

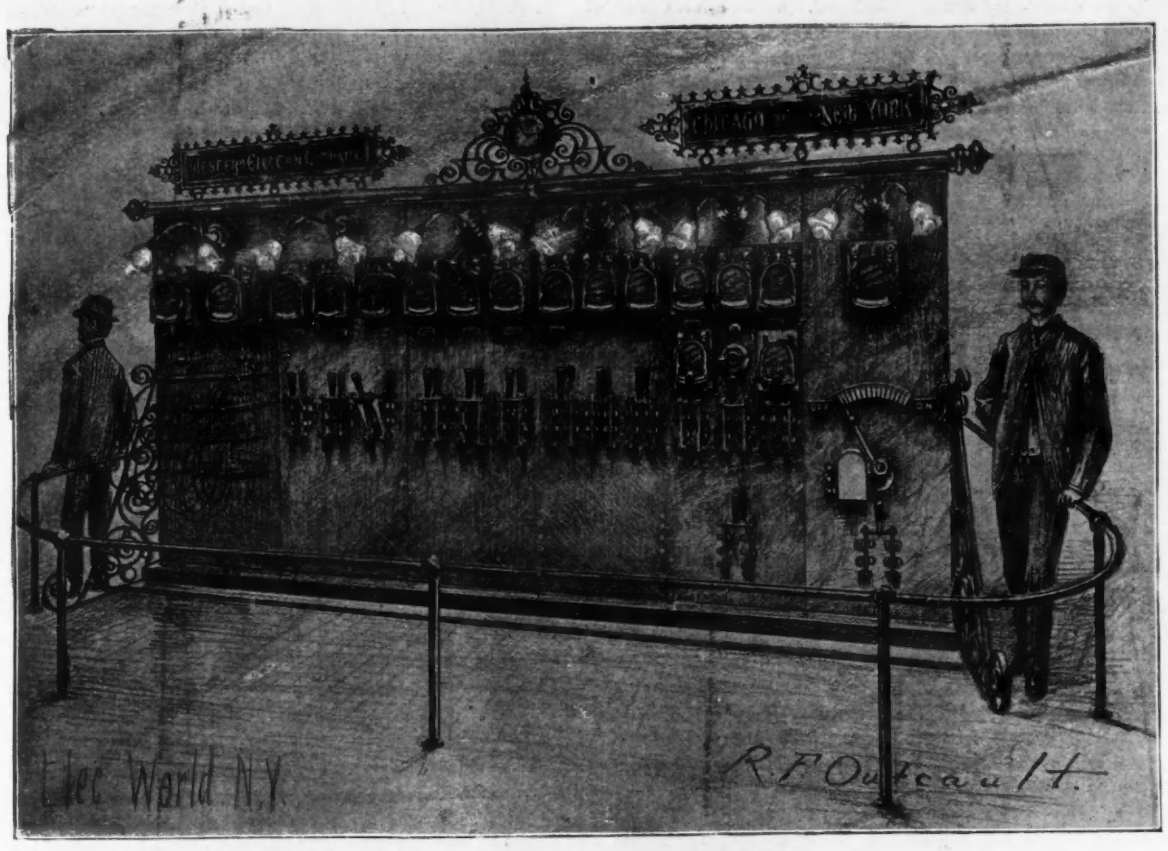
All kinds of "spring jacks," "drops," "listening keys," "ringing keys" and other parts of switchboards fill two large showcases in a confusing array, and serve to impress one with the complex nature of telephone switchboard work.

In the exhibit of switchboards the Western Electric Company has tried to show the changes of ten years, which in the telephone business means ages. There is a reproduction of the type of "standard" switchboards for 50 lines used in 1883, with its large annunciators and heavy spring jacks; near this is a model of a telephone exchange as used in 1893. Between these two types an interesting growth is shown. One of the first boards of the multiple pattern is reproduced in every detail. This board, designed in 1884, has long cords overhead, the operator working in a standing position. The annunciators are of large size and the spring jacks heavy. Boards almost like this are in use to-day at Kansas City and Indianapolis, while within the last six months a section of this style has been sent from Chicago to Budapest, Austro-Hungary. The next type shows a decided change. The annunciators and spring jacks are much smaller; the cords come up from below, and while the annunciators are still at the top of the frame the operator can sit at her work. This is a reproduction of the board now in use at Nashville, Tenn. In the next, or Antwerp model, the use of answering or local spring jacks is noted. The operator's keys are on a low shelf, the cords on a higher and the annunciators between, with the spring jacks above. This type was extensively used, and the present exchanges at Cincinnati and San Francisco are after its pattern. A single-cord board of the style used at Portland, Ore., Providence, R. I., and other places shows this method of working. Each subscriber's line has a cord and switch of its own, so that to answer a call and make the connection requires but few motions. The four boards just described were designed for grounded circuits only, but with the use of metallic circuits other designs became necessary. Two good types of the first metallic circuit-boards are shown—those used at Buffalo, N. Y., and at the Thirty-eighth Street Exchange, New York. The frames of these vary somewhat from former types, while the keyboard apparatus is more complex, and double conductor plugs and cords are used. A section of board such as is used in many small exchanges in New England makes a handsome appearance, as does the last switchboard before the Model Exchange is reached. These last are metallic circuit boards as made in 1891.

The Model Exchange begins with 100 pairs of underground cables, coming up from beneath the floor to terminals; from thence cables pass to the main distributing board, which is of the latest type, complete with strong current protectors and fuses. Next in line is the intermediate distributing board. These distributing boards have sufficient cables and "jumper" wires to show their working. Beyond these come one and one-half sections of the multiple switchboard of the latest and most approved style. The frame has a capacity for 5,400 subscribers' lines and 240 trunk lines, and it is equipped with spring jacks and cables to its utmost capacity. The mass of cables at the back gives the uninitiated a fair idea of the complex nature of a multiple switchboard and the chances for trouble in its working. Within a space of 69⅜ by 26 inches (the face dimensions of the spring jacks) the entire 5,640 lines can be reached. Each line requires, through the switchboard, three conductors, making 16,820 conductors which must be kept insulated from each other. The sectional area of this mass of cables is about 26 by 6 inches. In constructing this board special attention has been given to the comfort of the operator. The keys and connecting apparatus are arranged on a shelf within easy working distance. The spring jacks are all opposite the operator, none being above an easy reach. The annunciators are, as in the oldest board, at the top, but, unlike the first boards, they reset themselves automatically. This is accomplished by working the annunciator with two magnets,

one of which responds to the call, allowing the armature to fall, while the other is controlled by a local circuit, so that the plugging-in in answer to the call draws the armature up once more, ready for use. The operator need never touch these annunciators. The spring jacks used with this bridging system do not break contact when plugged into. The keyboards of this switchboard are hinged so that they can be opened like a trap door, and repairs or inspection of the keys made.

An almost exact duplicate of this switchboard is in use in the exhibit of the American Bell Telephone Company, for which purpose it was designed and installed by the Western Electric Company.



THE SWITCHBOARD.

Besides all these multiple switchboards there are many forms of small or standard switchboards, as well as desks and cabinets for switching purposes. Drawings of the circuits employed in the various boards are displayed, making an interesting study to notice the changes from the first standard switchboard to the multiple board of the present day. It is safe to say that this display constitutes the most complete exhibit of telephones and switchboard apparatus ever shown, and it is one well worthy of careful study by the telephone fraternity.

Adjoining the switchboard exhibit there has been erected a model subway, after the pattern of what is known as the Patterson subway. In this it will be remembered that the conduits come into a rectangular manhole at the angles instead of at the sides, and the cables are carried around the sides instead of directly across the space obstructing the manway. The advantage of this arrangement, where it is possible to employ it, lies in that the cables, in being carried from the ducts to the sides, require to be bent through a lesser angle than is the case where they enter the manhole in the middle of the sides. A convenient form of subway drawing-in capstan and skid are also shown.

Just north of this will be found the Patterson cable exhibit, which embraces reels of lead covered telephone cable, all of which is insulated with paper. All of these cables are now made dry. Some years ago the American Bell Telephone Company had a committee appointed to draw up specifications for the manufacture of telephone cables, and as a result a maximum capacity of .08 microfarad was determined upon. All telephone cables are now made according to these specifications, and paraffine and cotton have been abandoned in their manufacture and paper substituted, because the latter is cheaper, and cables thus insulated have considerably less capacity than those made by the former process. An entire revolution has therefore occurred in the process of cable manufacture for telephone purposes within the past two years. Of course, with this paper insulation, it is impossible to draw the cable into the lead tubing, as was formerly the custom in the manufacture of Patterson cables, but the lead tubing is now made around the cable by means of a lead press.

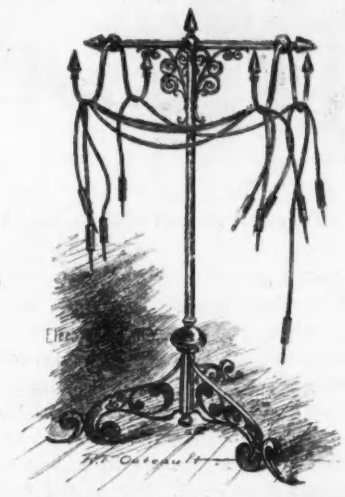
Among the displays of Patterson cables are those containing 150 pairs of conductors, measuring 2¾ inches in outside diameter, those containing 100 pairs, 2⅛ inches in diameter, and 50 pairs, 1¾ inches in diameter. We have stated that paraffine and cotton are not used in telephone cables. An exception is made, however, in submarine cables, for these are insulated with cotton saturated with paraffine. They are also armored on the outside. Samples of these are also shown. Samples of splices of telephone cables and telephone terminal boxes can also be found in this part of the exhibit. A large assortment of magnet wires, switchboard cables, weather-proof and office wires and cables of various other kinds are also displayed here. Upon a table are found spools of silk-covered magnet wires varying in size from 12 to 38; cotton covered annunciator and office wires are also displayed in large profusion.

In the extreme northwest corner of this block, as shown on the plan of the display, to the east of the aisle, is a novel little instrument, which has excited the curiosity of many passers-by by its peculiar and at first unintelligible motion. It is a wooden finger some 18 inches long, terminating in a ground glass incandescent bulb, the whole mounted upon a neat little oak cabinet. This finger is forever and eternally changing its direction, and if one were to attempt following with the eye every object to which it seems to be pointing he would be under the painful necessity of calling upon an oculist very shortly for treatment for strabismus. A word of explanation, however, will enable visitors to avoid such a necessity, for this finger is not pointing to anything, but busily engaged all the time in writing on the air the words Western Electric Company. The mechanism by which this motion is obtained will be explained later under the head of "Writing Machines," of which there are two here, and which will be seen to be exceedingly simple, though no less ingenious because of their simplicity.

Directly opposite across the aisle from the cable display is erected the police patrol call-box display and electrical apparatus pertaining to the system of annunciators. Three model patrol boxes have been erected here in oak, and the central posts around which they are built are tastefully illuminated, each with four electric lamps with vari-color shades. A large number of annunciators for private houses and for hotels are attractively displayed upon a large oak partition, but in these days of luxurious homes it is not unusual for a gentleman contemplating building a residence to have his architect plan an annunciator in keeping with the other fittings. These are not infrequently combined with a clock, and samples of these specially designed instruments are exhibited.

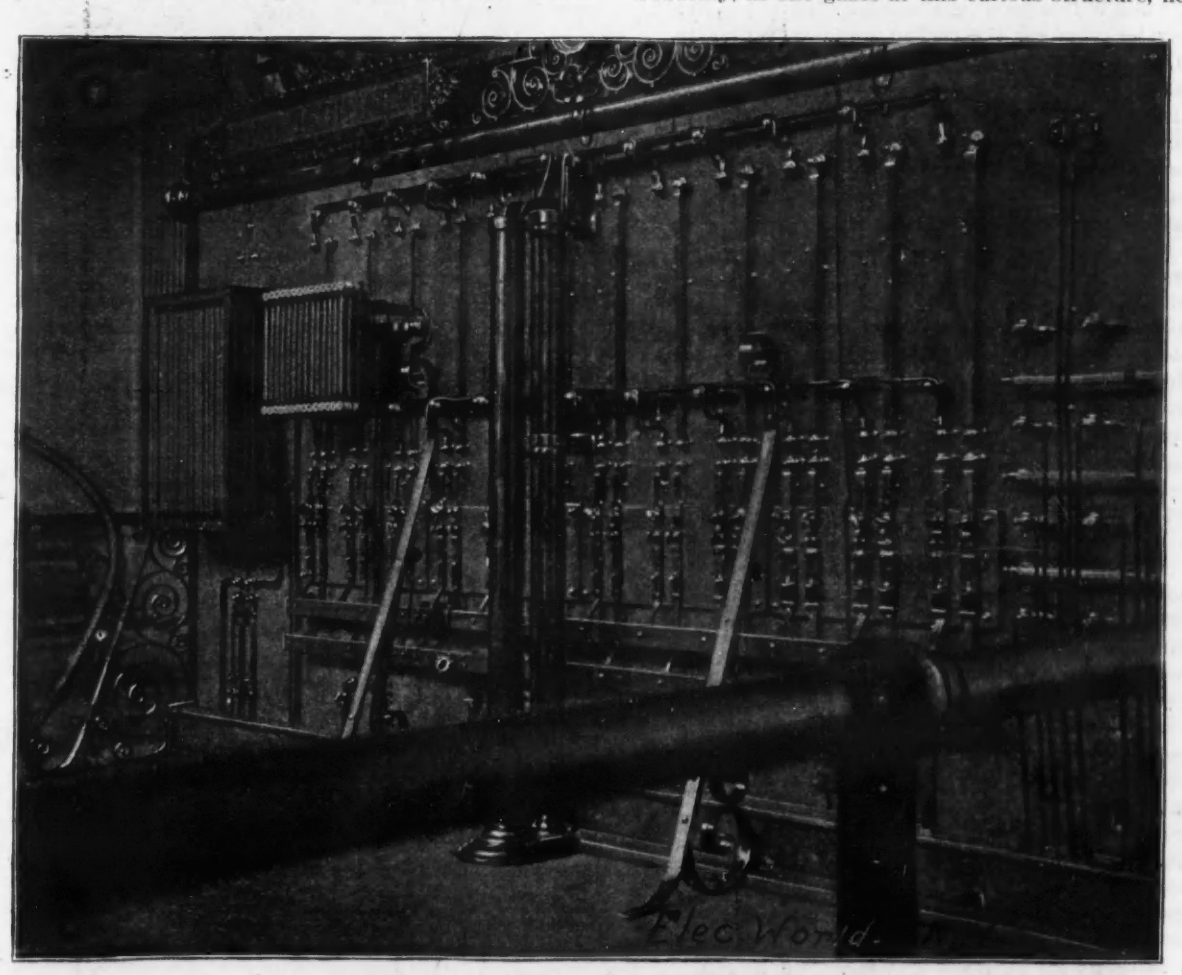
THE LIGHTNING TOWER.

In the exact centre of the Western Electric Company's exhibit rises what has become known as the lightning tower, which is a cylindrical shaft rising from the floor to near the ceiling, which is here the floor of the gallery. This is one mass of 16-c. p. lamps laid en echelon, so as to completely cover the timber of which the pillar is composed. While these lamps are arranged in horizontal circles, the colors are arranged in spirals, each about two feet wide, and alternating in red, white and blue. From the top, extending to the four corners of the exhibit, just beneath the gallery floor, are arranged four streamers of lamps in the conventional zigzag form of a lightning flash, and these lamps, too, are in the primary colors. At the termini of two of these flashes (at the northwest and southeast corners of the exhibit) are hung large globes similarly decked with lamps of the different colors, and these globes are kept in continual rotation by means of small motors, through worm gear. The two other streamers terminate in stationary clusters of lights, which follow each other in different colors, when it comes their turn.



LOOP RACK FOR ARC SWITCHBOARD.

Suddenly, as one gazes at this curious structure, he is startled by a zone of light issuing from the floor and rapidly progressing upward to the top of the column, where it seemingly lingers for a moment before leaping, and then leaves the column and branches out into the four streaks of lightning before mentioned. These it traverses rapidly, leaving behind it a trail of darkness as it eats its way into the darkness before it, and finally disappears in the terminal globes and pendants. It disappears for only a moment, however, for



THE BACK OF THE SWITCHBOARD.

immediately the latter flash out first in ribs of beautiful blue, then red, then white. This is repeated three times, when all is darkness for a moment, and a new zone of light starts up from the floor again and goes over the same programme. Thus, all day long, and

ENTRANCE TO THE SCENIC THEATRE.

when the buildings are open in the evening, too, does this weird display repeat itself. It is entirely automatic, and when the current is once turned on the show commences, and will continue as long as the current lasts. It forms an exceedingly striking exhibit, and while it is in no sense artistic, it is novel and fascinating, and through all hours of the day and evening, when it is in operation, it has a crowd of curious spectators around it. Nor is the company willing that these people shall go away without knowing how this is all accomplished, for they have provided a means by which the people may satisfy their curiosity. The mechanism is in the basement, but over this they have left an aperture and boxed it in with a window through which the whole operation may be viewed.

The commutator by which the various circuits are thrown in and out of action consists of a long cylinder made up of wooded discs a foot in diameter. On the periphery of each of these discs is placed a cam, which trips up a lever as it passes, and makes and holds a carbon contact for a few moments of time. In order that there may be room for the carbon contacts, the cams which trip the levers on one side of the drum alternate with those that trip the levers on the other side. The contacts are made in regular sequence down one side of the drum and up the other until those contacts are reached which connect with the colors on the globes and pendants at the ends of the lightning flashes. These we have seen repeat themselves three times, and to accomplish this the cams on those discs are arranged accordingly. The current comes up through the centre beneath the cylinder and is carried thence to copper strips along the boards upon which the levers on either side are connected. Each lever is electrically connected with one or the other of these copper strips and terminates in a clamp holding a piece of carbon. This, when depressed, makes contact with another piece of carbon flexibly suspended on a copper spring. The normal position of these carbons is apart, as shown in Fig. 9, and this separation is maintained by the coiled spring, as shown. The most interesting feature of this device is the provision for blowing out the arc. Near at hand, under both rows of contacts, runs a tube connected with a fan, and from this rises a small nozzle for each contact, so directed as to cause a stream of air to continually impinge upon the carbons, and by this means they are always kept cool and arcing is prevented, although a current of 25 amperes is thus broken. Corresponding to each lever there is placed near by an incandescent lamp of the color corresponding to that controlled by that circuit, so that one looking down through the scuttle not only sees the movement of the commutator, but also the play of colors resulting. The cams are so arranged that usually seven levers are depressed at a time, and since each circuit controls one circle of lights on the pillar, the zone of light creeping up is seven lamps deep or wide. The motion of this zone—the increase on the upper side and the decrease on the lower, which constitutes the progressive movement—is so rapid and perplexing that the eye cannot detect how wide it is, measured in rows of lamps, but it may be interesting to know the actual width, which is as above stated.

There are on the column 68 rows of 16-c. p. lamps—20 lamps in a row, making 1,360 lamps. Each group of 20 constitutes a separate circuit, which is fed by a conductor of 26,251 circular mils sectional area. This comes direct from the switchboard through the commutator. There is a common return having a section of 66,000 circular mils.

Each of the four lightning streamers is composed of 150 lamps, making 600 in all. Of these, 300 are white, 150 blue and 150 red. There is a common return for each of the streamers, each 41,743 circular mils section, uniting together at the junction of the streamers into the common return of the column section. In the streamers there are 56 branch circuits, each having a section of 4,107 circular mils. The revolving globes each carry 276 16-c. p. lamps = 552 8-c. p., and a circuit of 105,593 circular mils section runs to each group of lamps, besides a conductor of 66,373 circular mils section to each motor. On each globe there are 92 red, 92 white and 92 blue lamps and the globes make 80 revolutions

SOUTHWESTERN FRONT OF THE EGYPTIAN TEMPLE.

per minute. In the two stationary pendants there are 120 lamps—60 red, 36 white and 24 blue.

Recapitulating, we have of 16-c. p. lamps:

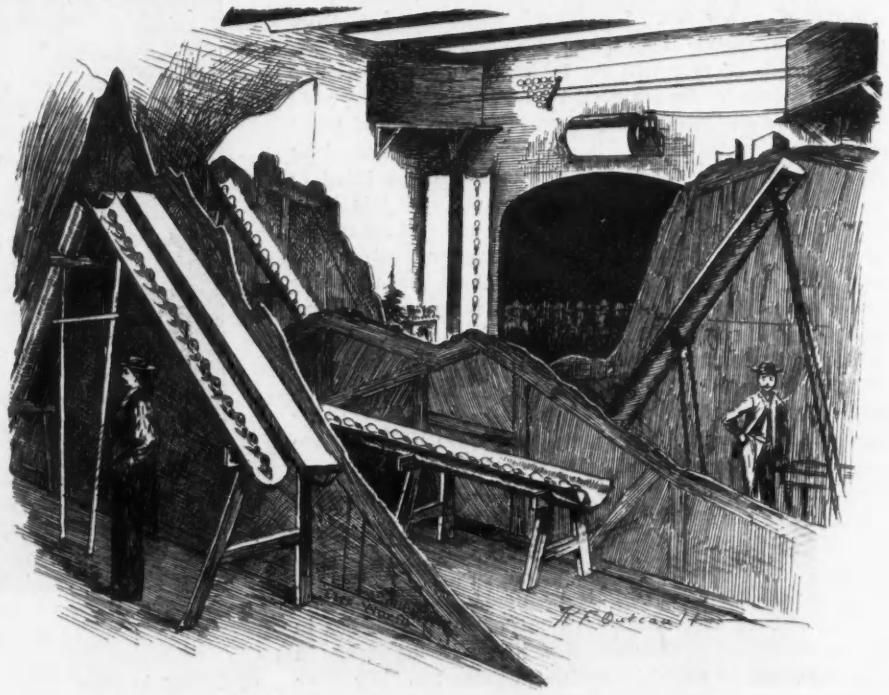
In pillar	1,360
In streamers	600
In revolving globes	552
In pendants	120
	2,632 lamps or 42,112 candles altogether.

On the Edison tower there are said to be about 4,000 5-c. p. lamps, which would give a total illumination of about 20,000 candles, or less than half that of this exhibit. This latter, however, is never totally illuminated, so its brilliancy is never so great as the candle power would imply. The motive power for the commutator cylinder is a ½-h. p. electric motor, and that of the revolving globes a ⅛-h. p. motor for each. In all three cases the reduction of speed is by worm gearing.

Facing the aisle which runs along the north side of the Western Electric Company's exhibit are three displays which are intended simply for amusement, and for this reason have been termed "fakes" by the representatives of the company. They are harmless, however, display great ingenuity and afford amusement to the passer-by. They are not only creditable to their originators, but to the authorities upon whose judgment depends the admission of exhibits. In all these respects they differ widely from those other numerous fakes, which, be it said with shame to those who are responsible, disgrace the otherwise beautiful and creditable electrical display at the World's Fair. Of these latter we shall have something to say at a future time perhaps; of the former we speak now, but only in praise.

Of one we have already spoken—the writing machine or finger. Just west of this across the aisle in a glass case is a beautiful model of a marine engine apparently driving an equally neat little Western Electric generator, which presumably furnishes current for a half-dozen 16-c. p. lamps. Visitors stop to admire the mechanical perfection of the little machines, and those who are posted as to the rule forbidding the use of steam in the Electricity Building wonder how this company have succeeded in evading the rule. We will only whisper in their ears that this company has a "pull," and it is this "pull" that runs the engine, not steam.

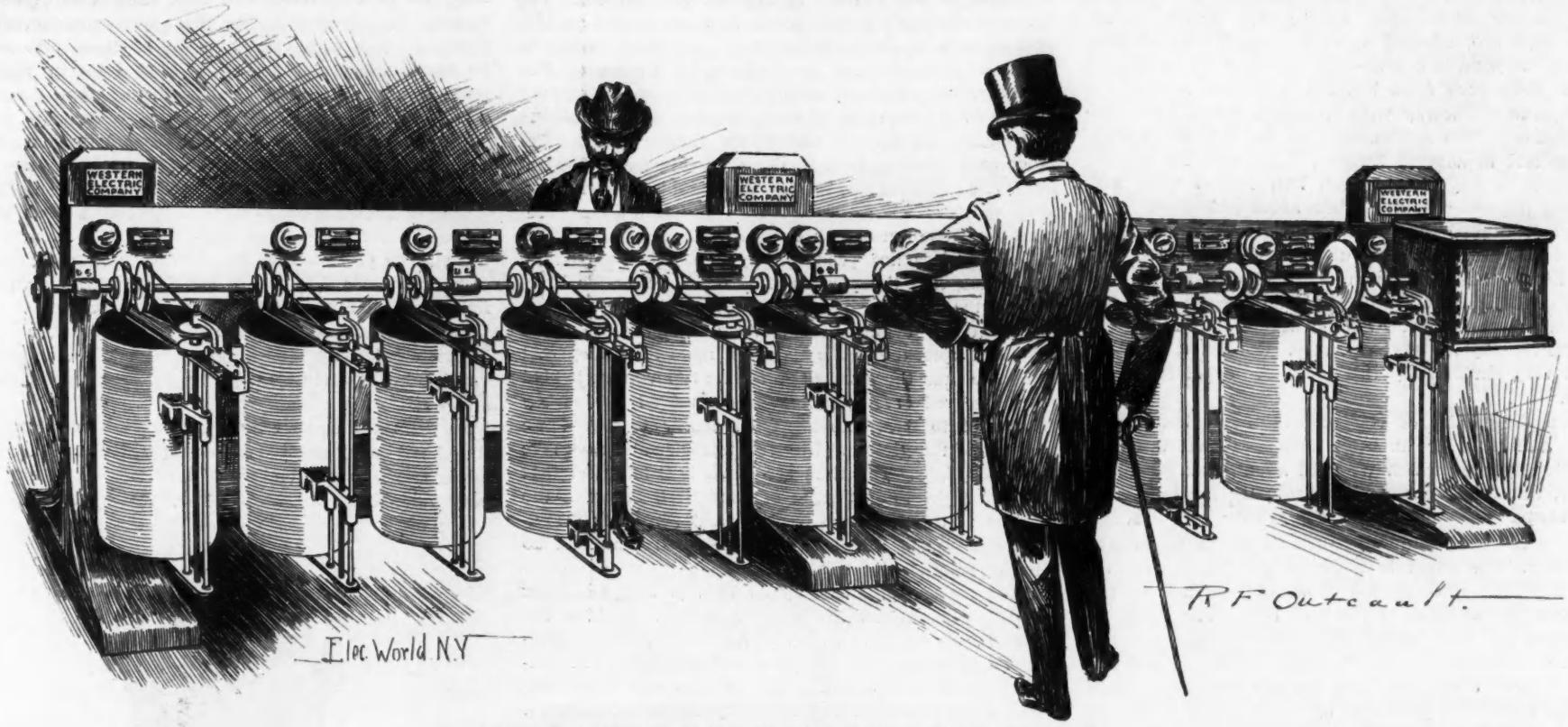
Next west comes a large display of batteries; these are not fakes, however, but west of these is a large oak case upon the top of which are outlined in incandescent lamps red, white and blue, the script letters W. E. Co. Behind these letters is a wooden pointer or finger every way like



A VIEW BEHIND THE SCENES OF THE SCENIC THEATRE.

the previously mentioned writing machine, except that it has no lamp at its end. It keeps in motion, however, describing in thin air the letters in front of it, and as fast as it moves the lamp at which it points lights up until the whole legend is written in air and also in fire. And then what does it do but retrace its evolutions, undoing

exactly what it had done before. Then it writes the letters again and rubs them out once more, only to repeat the same thing over and over again and all day long. The finger never touches the lamps, but its movements and the illumination or extinguishment of the lamps occur simultaneously. Certainly one must be the cause and the other the effect, but which is which is the question. We have seen an incandescent lamp bulb light up to full brilliancy by the mere pointing at it of Mr. Tesla's finger, but this is not a phenomenon of that kind. The lamps in this case would go on lighting up and becoming dark just as well without the magic wand as with it, and only necessary to place it on the same carriage as the rollers and to add to it two other motions at right angles to each other which were the rectangular components of the letters to be described. To accomplish this two boards were nailed to each other at right angles, and in their vertical and horizontal faces grooves were cut which corresponded to the two curves which these components would make when combined with the travel of the carriage. In these grooves run two rollers which, through their rigid connections, are pivotally connected to the inner end of the finger. The latter is, therefore, compelled to assume a motion which in direction and extent is the resultant of the two motions. In the case of the finger with the lamp on its point there is no motion of translation of the finger, so the letters which it describes are written over each other in the same space just as would be the case with a pen on paper if, after writing the first letter of a word, the pen were not moved along before writing the second. In this case, however, there is a motion of translation to the wand, so that when it describes each successive stroke it is just behind the same curve in the sign. This resolving of curves into their rectangular components is familiarly exemplified in the pantograph, and has found its most marvelous development in the newly perfected telautograph of Prof. Gray, so fully described and illustrated in our issue of March 25.



CONTROLLING RHEOSTATS FOR THE SCENIC THEATRE.

THE SCENIC THEATRE.

Perhaps the part of this company's display that will be most generally appreciated by the public at large is this is done by two rollers in the back part of the case hidden from view, which are driven back and forth over a series of contacts controlling the lamps by a nut and screw actuated by a smaller motor on the floor. The finger was an afterthought, and to cause it to describe the letters in unison with the action of the lamps it was

SUNRISE EFFECT IN THE SCENIC THEATRE.

the scenic theatre, which stands just north of the industrial display. Here has been constructed a small building with full stage equipment, with which are shown some beautiful stage-lighting effects such as are producible only by means of the electric light. The auditorium, which, unfortunately, is quite limited in

capacity, hardly admitting with close crowding as many as 100 people, is supposed to be a balcony, from which the audience look out upon an Alpine scene. In the immediate foreground is a grassy terrace with miniature electric fountains on either hand bursting forth from amid clusters of flowers. These fountains are real, and the jets are illuminated axially by electric lights, whose rays are reflected upward through colored glass screens. Beyond is a little lake into which a miniature stream debouches from beneath a Roman bridge. On the right is a gateway with sphinxes, which guard the approaches to the battlements on the heigths beyond. On the left is a rural Swiss village with its church, parsonage, a hay rick, wagon half loaded with hay, plowing implements and other accompaniments of a properly equipped rural scene. Thus far all is in true perspective. In the middle distance is a range of foot hills, at the base of which is an obscured lake, the source of the watercourse being in the foreground. In the distance are the snow-clad Alps, which, of course, form the real centrepiece of the picture. Our artist has portrayed very successfully this scene in one of its many moods.

At the beginning of the entertainment both auditorium and stage are in utter darkness—that tangible, palpable darkness which we read about, and then, one by one, the stars appear, and gradually the landscape takes shape in the moonlight, whose rays first kiss the highest peaks and gradually work their way down into the valley. The effect is much heightened by the reflection of the moon's rays from the surface of the little lake at the base of the foot hills. The lights in the houses at first show brilliantly through the unshuttered windows, but as the night wears on and the moon begins to set they one by one disappear. This moonlight effect is produced by three green lamps of 16 c. p., which are drawn across the stage over the proscenium arch from right to left. Next comes the break of day, with its cold gray lights, warming up gradually with the blush of dawn. The purples in the valleys and the grays above gradually give place to the rosier tints, and the snow-capped peaks are at last touched with Aurora's tints of brilliant red. From the crest these reds gradually creep down to the little village in the foreground, and then, eclipsed by the greater brilliancy of the direct sun's rays in the east, give place to the pure whites in the east. Then comes the sunset, which gives another opportunity for pretty light effects, and the evening ends the display as it commenced, with darkness obscuring the scene.

To many the means of accomplishing these beautifully realistic light effects will prove not less interesting than the effects themselves, and for the purpose of enlightening these we will take our readers behind the scenes. Mr. Outeault has given us a very good view of what is here to be seen, and this will enable us to describe the arrangement more clearly.

On either side of the proscenium are two upright rows of light, the two outside ones each containing eight white lamps of 16 c. p. These reflectors are each covered with ruby glass. The two inner ones each contain eight blue lamps of 32 nominal candle power. These four are known as the proscenium lights. Overhead both to the right and left of the stage, are two red screens, shaded from a very deep to a very light tint; and running on a track from behind the right hand screen to the left hand one, is a pyramidal group of 15 32-c. p. white lamps. This is the sun. Above this, on a similar track, is a group of three green lamps for moon effects. In the centre, over the proscenium arch, is the sunrise drum, which permits the rays of three 32-c. p. lamps to diverge through a slit. This is belted to the rheostat shaft outside the theatre, and is caused to revolve slowly—its rays first touching the highest peaks and gradually working down, so that they embrace the whole scene. These rays pass through red glass for sunrise effects.

In the ceiling there are three rows of lights called borders—the one nearest the front consisting of 16 16-c. p. lamps behind white ground glass used for the gray of dawn; that in the centre of 20 16-c. p. lamps, behind red glass, and the one in the rear of 26 32-c. p. blue lamps.

Back of the scene near the front are two reflectors is the set of rheostats by which the graduation of lights horizontal reflector with 16 blue lamps of 32 c. p., and back of the high mountains two inverted V-shaped reflectors—the upper one containing 29 blue lamps of 32 c. p. for sky effects, and the inner one 32 red lights of 16 c. p. for red horizon effects.

Outside the building, arranged along its northern side, are the set of rheostats by which the gradation of lights is automatically controlled. There are 11 of these rheostats which consist of sheet iron drums 10 inches in diameter and 20 inches high. These are first wrapped with asbestos and then wound with German silver wire imbedded in plaster-of-paris. The contacts which run over the bare surface of each resistance coil consist of five wheels at the ends of bellcrank levers held against the cylinder by coiled springs, and are moved longitudinally along the cylinder by a screw attachment driven from a shaft making 40 revolutions per minute. An automatic attachment at either end of the screw guides causes the carriage which carries the contacts to come to a standstill at any predetermined point or to reverse its direction of motion at will. The whole contrivance is new and ingenious and provides for a gradual shading of the light unattainable by hand control. From these 11 rheostats are carried 17 circuits, and although the lamps used are all 80-volt lamps they are placed on 110-volt circuits, so that the brilliancy obtainable is far in excess of that indicated by the label on the lamps. For the moonlight effect the green lamps are used as already stated. At the breaking of dawn the sun is non-luminous and behind the densest part of the sunrise screen. The blues and the reds, both in the proscenium and borders as well as behind the scenes, are gradually turned on with the sun, which latter comes to full brilliancy behind the dense red before it commences its journey. The red sky colors are produced by the reds behind the mountains, and the purples of the valleys by the blues behind the foothills and on the proscenium. Next the sunrise drum begins to revolve, casting reflected red rays first upon the peaks and then upon the valley. At the same time the sun has gotten its full voltage behind the dense red screen, and has commenced its journey from east to west, moving from denser to less dense portions of the glass until its full unobstructed rays give bright daylight. The time for dawn is 2 minutes; that from starlight to beginning of sunlight 6 minutes; the journey of the sun from east to west consumes 8 minutes, and sunset occupies 6 minutes more, making 20 minutes from starlight to starlight.

The stars are produced by 30 16-c. p. lamps shining through perforations in the canvas sky. Besides the above effects there will be a storm scene with its thunder and lightning, and finally a beautiful rainbow in realistic manner grows before the eyes as one views the scene, only to fade away again by insensible degrees. The lightning effect is produced by an entirely new process invented by Mr. Patterson, and the rainbow is likewise entirely new, never having before been successfully accomplished. This discovery is the invention of Mr. Tucker, who shares the credit with Mr. Patterson of having designed and brought to completion this most beautiful display.

The whole arrangement is automatic, and is intended when once adjusted to repeat itself every 20 minutes or half hour without more atention from those in charge than the mere starting of the rheostat shaft. This whole display of the Western Electric Company, as before stated, reflects great credit upon its designers and upon those who, by financial encouragement, have rendered its completion possible.

The Elrctrical Fountains at the World's Fair.

Both electric fountains were displayed with full head of water Thursday evening, June 15, for the first time, as far as the water display was concerned, with great success. But the illumination was an intense disappointment to the throngs that had expected so much. It is not fair to criticise this display at this time, for it was the initial test of the electrical equipment, and we trust that the grave errors in design which have now, for the first time, been made publicly manifest, will be corrected so as to make these fountains what they should be—the crowning glory of the electrical exhibit. By the turning on of a water valve by an exhibition employee, one of the engines in the generating plant of the Western Electric Company was wrecked Thursday afternoon. The valve connected with the condenser and its turning on flooded one of the engine cylinders with water at 40 pounds pressure. Another engine was soon thrown into service, however, and the illumination in the Electricity Building in the evening was not interfered with, although some lights in the Transportation Building were sacrificed to accomplish this.

The Hardtmuth Carbon Exhibit.

Near the northwest corner of Electricity Building, midway between the displays of the Elektron Manufacturing Company and L. J. Wing & Co., may be seen a handsome architectural pile which at once attracts attention.

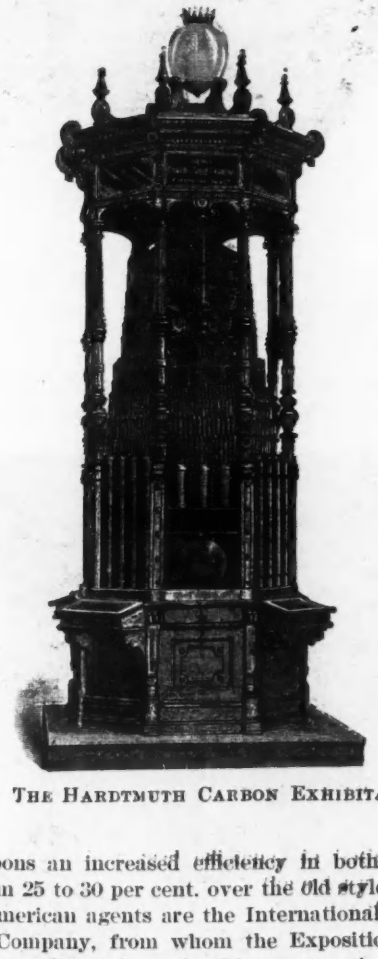
At a distance, its purpose other than that of pure ornament could scarcely be divined, but on closer approach it is seen that the well known and extensive carbon manufacturers, F. Hardmuth & Co., of Vienna, have adopted this tasteful method of displaying their wares. Thus they have made the homely but useful carbon contribute to the artistic beauty of its surroundings, and while not brilliant in its own substance, it adds brilliancy by its contrast.

Those familiar with the history of arc lighting know the difficulties that were encountered in adopting the arc light to incandescent circuits, and that arc lighting by the constant current was already old, as electrical things go, before much that was accomplished in this line on constant potential circuits. Besides the difficulties of regulation and feed on circuits of the latter character, there were others of a grave nature which were not met with in the older method of distribution, and perhaps the most serious of these was the manufacture of a suitable carbon adapted to the new conditions. A hard and dense pencil, which answered all requirements on constant current circuits, proved by far less satisfactory in the new adaptation. Long experiment with material finally demonstrated that a softer carbon was now required, but while this proved better in some respects it still lacked much in others. The maintenance of a suitable crater always central to the pencil was a sine qua non, and great progress had been made when the cored carbon was introduced. But there were many other difficulties which were encountered, and these also had to be surmounted, and how they have been by different manufacturers is usually kept by them jealously as trade secrets.

Messrs. Hardmuth & Co., who are among the largest manufacturers of carbons in all Europe, have long been working in this field, and the excellence of their product, which is known here as well as abroad, attests to the success which they have met. How they have solved the various problems would form an interesting chapter were it written, but the material for such a chapter is for the reason above assigned unobtainable.

The architectural structure of which we have spoken is composed almost entirely of their carbons in sizes varying in diameter from ⅛-inch to 3 inches, both cored and solid.

Notwithstanding that their carbons are more expensive they have boldly entered into competition with our home manufacture, being emboldened to take this step by a very valuable recent discovery by which they claim for



The Hardtmuth Carbon Exhibit.

their carbons an increased efficiency in both light and life of from 25 to 30 per cent. over the old style carbons.

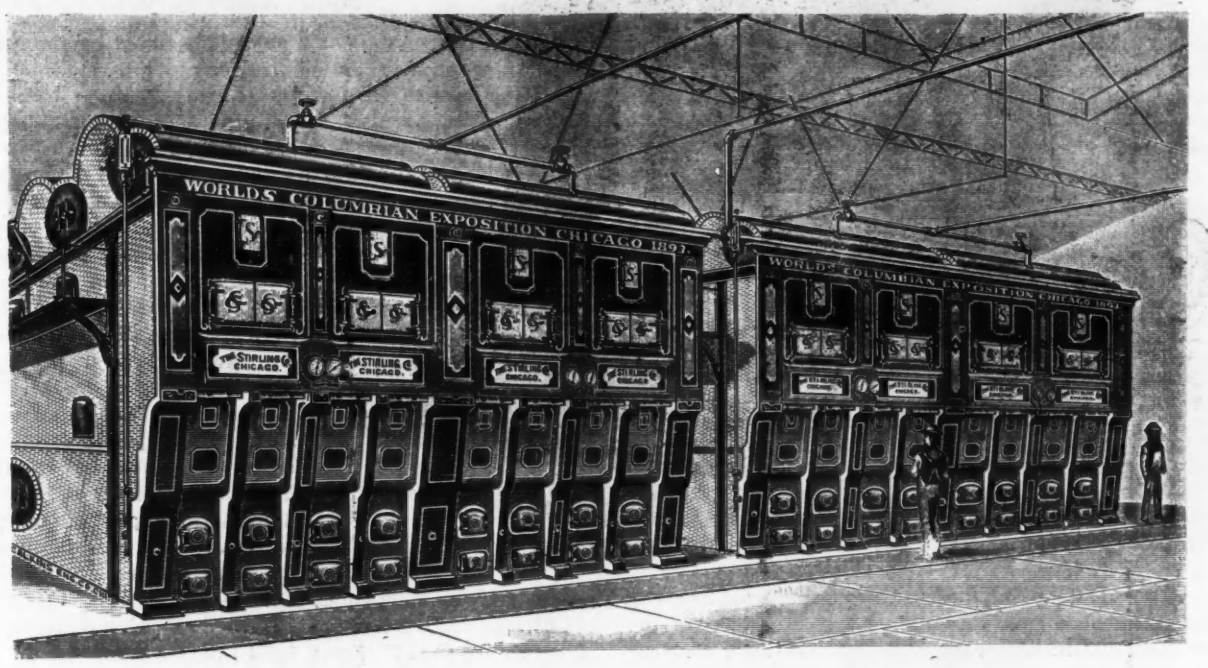
Their American agents are the International Thomson-Houston Company, from whom the Exposition authorities have purchased large lots for use on incandescent circuits within the Fair Grounds. Among the uses to which these have been put already are the arc light illumination of the electrical fountains and the United States battleship "Illinois." These carbons have also been employed in the illumination of the Grand Basin.

The Stirling Boiler Exhibit.

Considerable interest attaches to the exhibit of water tube boilers made by the Stirling Company, both by reason of the character of the exhibit itself and on account of the circumstances under which it was made. It will be recalled by most of our readers that when the Exposition Company first advertised for bids for boilers for the Fair, the Stirling Company submitted the lowest bid; that subsequently when it was determined to rent boilers instead of buying them, a contract was made between the Exposition and the manufacturers of six other boilers without the Stirling Company being consulted. The Stirling Company looked upon this as an effort to keep it out of the field entirely. When it developed later that more power would be needed than had been provided, the Stirling Company applied to the Exposition Company for the privilege of installing its boilers in the space that remained, on the same terms that had been made by the other boiler companies. The application, however, was refused. Appealing to the Council of Administration, the Stirling people secured a reversal of the decision of the Exposition management, and were awarded a contract, under which they proceeded to install two batteries of 800 h. p. each in the main boiler room. An application was then made to the courts for an injunction to restrain the Exposition Company from permitting the Stirling Company to install its boilers in the main boiler room, but was finally dismissed by Judge Grosscup, of the United States District Court, with costs against the complainant. The Stirling Company thereupon resumed the erection of its boilers, and its exhibit in the main boiler room is the result.

The exhibit is a most creditable one, and consists of three separate and distinct plants, aggregating 2,800 h. p., comprising two separate batteries, each containing two boilers of 400 h. p., in the main boiler room; one battery of two boilers of 400 h. p. each in the boiler room annex, and one battery of two boilers of 200 h. p. in operation at the Libbey Glass Company's exhibit in the Midway Plaisance.

The exhibit in the main boiler room is located at the extreme west end of the room and is conspicuous both by reason of the massive and generally "solid" appearance of the boilers themselves and by reason of their color, a radical departure from the beaten path having been made in painting them white, with silver trimmings, the object being to have the plant in operation appear as "a thing of beauty," etc., in its cleanliness, as well as a model steam producer in economy, efficiency and safety.



THE STERLING BOILER EXHIBIT.

The general construction of the boiler is familiar to most of our readers, but in brief it consists of three upper steam drums and one lower mud drum, respectively 36 and 42 inches diameter, all connected by means of 3¼-inch tubes, which are expanded directly into the drums, and so bent as to allow for the varying degrees of expansion and contraction. In one end of each drum is a 16-inch manhole faced elliptically, against which a plate may be fitted and held in place by wrought steel bolts. The removal of these manhole plates gives access to every tube in the boiler, and the drums are large enough to enable a man to work inside conveniently. The water is fed into the rear upper drum, and flows through to the mud drum beneath, coming in contact in its descent with the ascending gases, and becoming heated to a sufficiently high temperature to cause the precipitation of magnesia, lime and other solid matter that the water may contain into the mud drum beneath. As a result the two front rows of tubes are filled with chemically pure water and all danger of scaling is thereby removed.

There is no cast metal used in the construction of the boiler, in consequence of which a higher pressure may be carried with absolute safety and without danger of explosion. The boiler is subjected to a cold water test of 200 pounds when erected, and is guaranteed by its manufacturers to stand a steady working pressure of 150 pounds.

One of the principal claims made for the "Stirling" is its ability to successfully handle very impure water, a claim which is well borne out by its operation at Pittsburgh, Wheeling, Cincinnati, Louisville, St. Louis and New Orleans, where the feed comes from the Ohio and Mississippi rivers in a very muddy and foul condition. At some of these points, notably Pittsburgh and Wheeling, it is claimed that the boilers have run day and night for months under a constant steam pressure of 150 pounds without being closed down for cleaning, the only work found necessary having been the opening of the blow-off cock two or three times in the twenty-four hours, and blowing down water one or two gauges.

EXHIBIT OF THE RELIANCE GAUGE COMPANY.

The Reliance Gauge Company, of Cleveland, O., has one of the most attractive exhibits on the second floor of the Electricity Building, showing a full line of its celebrated Reliance Safety Alarm Water Columns for steam boilers. These are shown in varying sizes, from those suitable for miniature boilers of single horse power to those large enough for use on boilers of 1,000 h. p.

The space alotted to this company has been covered with handsome brussels carpet, and has been richly tastefully furnished with chairs, tables and other office equipment. In the background has been erected a sample-board, if such it may be called, upon which are displayed the various specimens of this company's handiwork in polished aluminum, brass and nickel. Back of all this, and at the two ends of its space, hang olive plush draperies which give to the space a very rich and drawing-room-like appearance.

For the benefit of those who are not versed in such matters, and as a reminder to those who are, it may be said that in all boilers there is a space not only for the water, but also for the steam. A proper proportioning of these two spaces is essential, not only to the economy of operation, but to safety. Should too much space be occupied by water the production of steam will be slower, its supply to the engine less regular, and the cost of generating will be unnecessarily high. If, on the other hand, too little space is given to the water, or through inattention to its inadequate supply, destruction comes to the boiler through overheating of those parts which are intended to be below the water surface, by unequal expansion, and in extreme cases by its complete destruction by disastrous explosions. Every experienced engineer knows that for a given type of boiler, the maximum efficiency of evaporation and greatest length of life of the boiler can only be obtained by the most careful attention to the water lines, which must not vary beyond a certain fixed maximum and minimum height. To enable the fireman to keep within these limits it is customary to place upon all boilers a series of water gauges by which the water level may be readily observed at all times, but as is too well known, through the carelessness of the man in charge or through the clogging of the water tubes, these limits are often allowed to be passed, and since there is no warning to others than the culpable one, nothing is known of his carelessness until the boiler has given out prematurely, or has suddenly taken to itself wings and fled. Some device which shall render such carelessness and neglect impossible, and which, like the watchman's time signal, will stand at all times a vigilant guard over his actions and give indisputable evidence of his neglect of duty, has long been a desideratum. Such a device is the Reliance Guage Co. exhibiting in its space, and it is attracting the well merited attention of steam users.

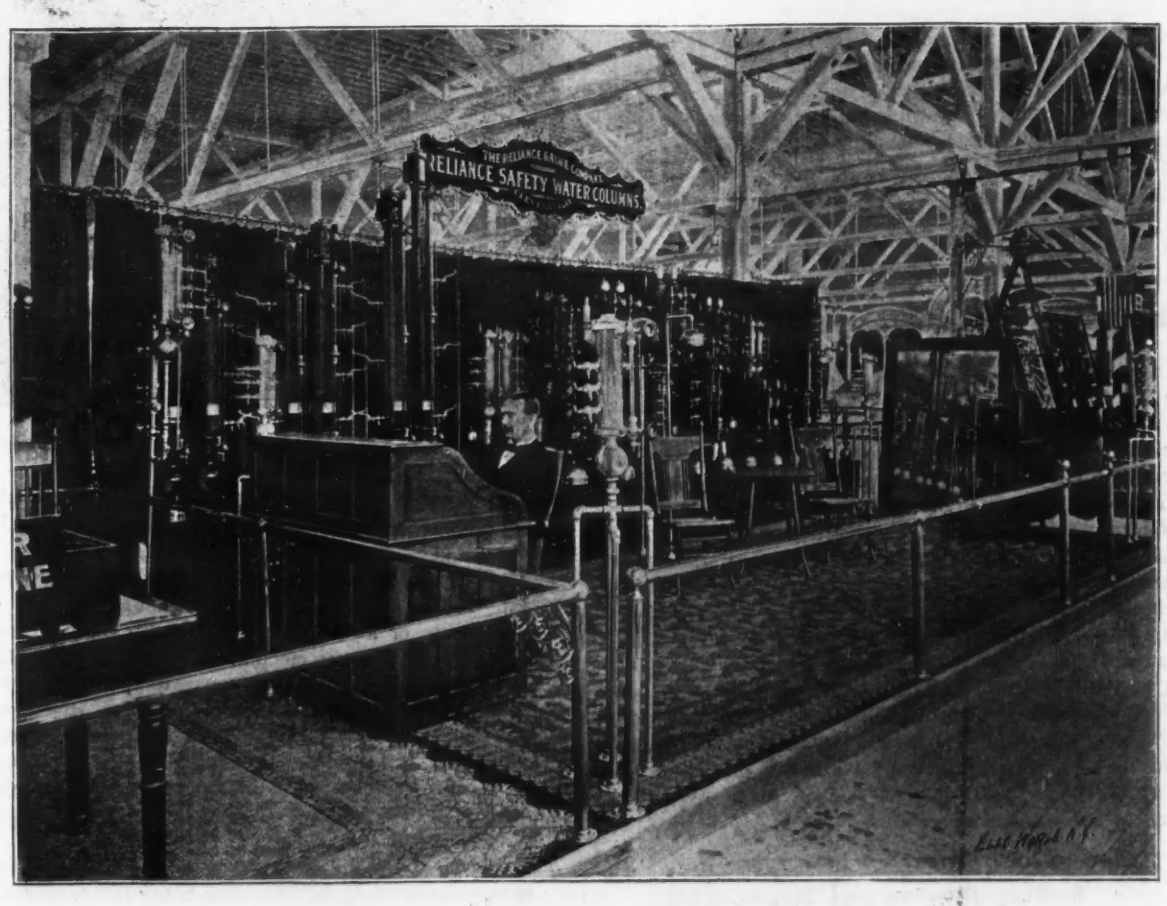


EXHIBIT OF THE RELIANCE GAUGE COMPANY.

The principle involved is this: Within the column are placed two floats and a valve, so arranged as not to interfere with each other or with the water-gauges or gauge-cocks, the latter being entirely separate and independent of the former. When the water rises to the third guage, the high water float raises the valve lever and an audible high water alarm is at once sounded, and continues sounding until the water is reduced within the superior limit. This alarm may be a steam whistle or an electric gong, and not only calls the attention of the fireman to his lapse of duty, but also of his superior to his carelessness. The adjustment of this device is so delicate that it is impossible for 1-16 of an inch excess of water to exist in the boiler without it being at once reported; thus a sufficiency of good dry steam generated under favorable conditions is always assured. On the other hand, when the water falls to the first gauge-cock, below which limit it should not be allowed to go, the low water float in like manner opens the low water alarm, which also continues to sound until the difficulty is rectified. The knowledge that the employer will be aware of his neglect not only spurs on the fireman to speedy action in correcting the difficulty, when it happens, but also keeps him alert to avoid its occurrence. In this manner all the evils which are due either to too much or to insufficient water, and which latter occasionally culminate in the explosion of the boiler itself, are rendered almost impossible. In fact, by the use of this device, the responsible man of the establishment is kept constantly aware of the fidelity of his firemen, or their faithfulness, as the case may be.

Another feature of the Reliance Water Column which gives it an advantage over the ordinary devices is the sediment chamber attached thereto, in which all sediment or foreign matter going through the feedpipe is entrapped. In the ordinary water column this matter, coming up, circulates through the column, dirties the water glass and even stops up the passageway by which it entered, and when it does fall back it remains in a position only to be returned again the next time the gauge cock is tried. The Reliance column, however, as before stated, feeds at the side, and has in addition a trap or sediment chamber in which the suspended matter finally settles, and where it cannot be disturbed again by the subsequent opening of the gauge. The water is always free to circulate through the column, and the glass remains clear.

All of these features must recommend this column to the steam user, as by keeping the water lines within bounds a saving of fuel is very apparent. The possibility of straining and burning of the boiler is almost entirely obviated, and in this way, too, through a greater length of life of the boiler itself, economy is subserved. The readers of The Electrical World will find in this display a number of easy-chairs in which to rest while inspecting the exhibit, and in Mr. George B. Clarke, who is in charge, a genial gentleman, who will be glad to explain the details of the apparatus by means of the full-sized instruments displayed, as well as by the small aluminum models so cut away as to show the various working parts.

An Electrical Wedding.

During the past few years electricity has been used in many unique ways. It has played a prominent part in the decorations of large balls and club functions, but a new departure in this line was made recently, the occasion being a "home wedding" in Brooklyn. The Issertel-Blakeman nuptials took place amid elaborate electrical decorations which almost took the place of the old-time floral display, as only trailing vines of smilax and bunches of daisies were used to conceal the necessary wires. Located directly between the French windows of the front drawing room was a graceful arch standing out about four feet from the wall. It was draped with tulle to form a dainty bower, over which hung trailing vines of smilax. The lamps forming the outer or under side of the arch were 16-c. p. frosted lamps peeping from delicately tinted glass shades, half concealed by green vines, while the interior of the dome was studded with green lights, producing a beautifully soft effect.

From every corner of the two spacious drawing rooms were festooned garlands of smilax, studded with colored lights, the festoons radiating from the centre chandeliers, which were draped with greens to form two large bells; from the heart of each hung a frosted 50-c. p. lamp.

Upon the mantels electric candelabra were placed (frosted tubular 16-c. p. lamps taking the place of candles), all wreathed in vines and banked with daisies.

The arch was so arranged by a series of switches that, as the bride and groom entered, the lights were turned on in a gradual manner, like the breaking of dawn.

First the colored rays of the festooned lamps; then the stronger, yet soft, glow of the green bulbs; then, finally, as the wedding party stood beneath the arch, all the frosted lights burst in a blaze of glory, making a spectacle both beautiful and dazzling. The musicians were hidden behind banks of palms, the branches of which were illuminated by frosted lights encased in beautifully covered Japanese lanterns.

These electrical effects were designed by the groom, Mr. Henry G. Issertel, electrical engineer, of the A. B. C. Co., and the installation was done by a number of his friends of this city, as a token of their esteem.

French Train Lighting.

The Paris-Lyon Mediteranee Railway Company is going to use the electric light in 50 of its first class cars. Multitubular Tommasi accumulators will be used. Each cell weighs 24 pounds, and they will be divided into four groups of three cells each, and each group placed in a box containing three compartments, which in turn will be in movable wrought iron tanks with wood lining in the interior. Each compartment will be lighted from a lantern containing two incandescent lamps of 10 c. p. and 20 volts. The weight of a movable box and the group of three elements is 120 pounds; the entire weight of the four boxes comprising the complete battery of 12 elements is 480 pounds. The total weight of the plates alone is 320 pounds. The total energy of the battery is 5,600 watt hours, and the total number of hours of lighting is 36, assuming a consumption of 38 watts for each lamp.

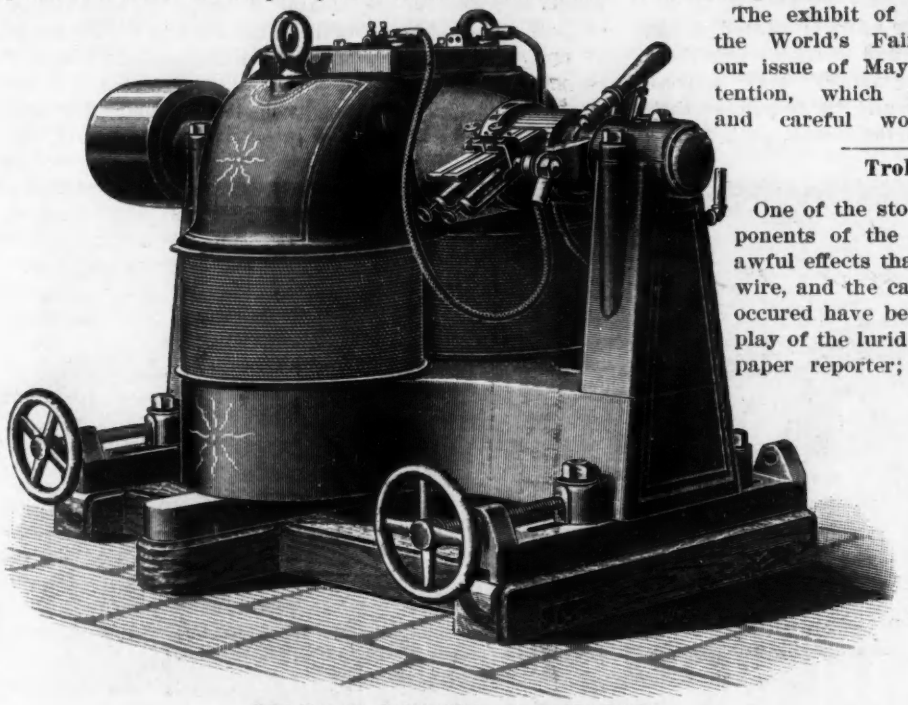
The Whitney Alternating Current Instrument.

In the illustrated article in The Electrical World of June 8, 1893, descriptive of the Whitney alternating current instrument, for which the Electrical Appliance Company, of Chicago, is the general Western agent, a slight error was made which might be misleading and for that reason should be pointed out. In speaking of the fact that the Whitney instruments could be used for the most careful measurements of any alternating currents without being affected by the variations in frequency, the following statement was made: "This has always been a great difficulty and has necessitated the recalibration of each instrument for the particular machine on which it was to be used, whereas the Weston instruments can be used on any kind of alternating current machines." This should have read Whitney instruments instead of Weston, as the context would indicate. It was the special aim of the article to call attention to this valuable feature in the Whitney alternating current instruments.

Belknap Dynamos and Motors.

The general principles of motor and dynamo design have become so widely known that it can no longer be claimed that any one dynamo on the market is the only one that will run and do good work. On the other hand, there is yet room for improvement in details, and in the Belknap motors and dynamos, manufactured by the Belknap Motor Company, Portland, Me., the greatest of attention has been paid to these and a number of strong points developed.

The armature consists of a series of thin, soft iron discs keyed to the shaft and separated by thin discs of paper forming the armature core. On the surface of the core is wound from one to four layers of insulated copper wire, according to the size of the machine. Great care is taken in laying this wire on to secure perfect insulation and mechanical firmness, and to avoid any displacement of the conductors by the severe strain that necessarily comes on them; for, as it is well known, the power applied to the pully of a dynamo and the power derived from the pulley of a motor are sustained



BELKNAP DYNAMO AND MOTOR.

by the conductors on the surface of the armature, and the conductors have to stand just that amount of mechanical strain; hence, the importance of rigid construction. The armatures are very carefully balanced, so that there is no jarring when the machine is running. The depth of winding on the armatures is small, to avoid self-induction in the armature, which prevents sparking, the field magnets being made correspondingly large and strong.

The commutator is made of pure copper (tempered), which experience has taught is superior to all other metal for this purpose. The arrangement of brush holders has been a subject of special attention. Experience has shown that the wear of brushes and commutator may be reduced to minimum by reducing the friction of the holder on its stud. It then requires a spring of but small tension to secure a sure contact of the brush. The holders in this machine secure this, and, as a result, the wear at the commutator is very small.

The field magnet is of the simple horseshoe type. The bedplate forms the yoke of the magnet and is made somewhat thicker at the point where the cores extend from it. The cores are circular in cross-section. The wire of the field is wound on a separate spool, made by placing a leatheroid head at each end of a sheet-iron sleeve. The winding of the field is thus made easily replaceable and spools thus enabled to be furnished wound for any voltage, if a change should be desired, which may be put on in a very short time with very little work.

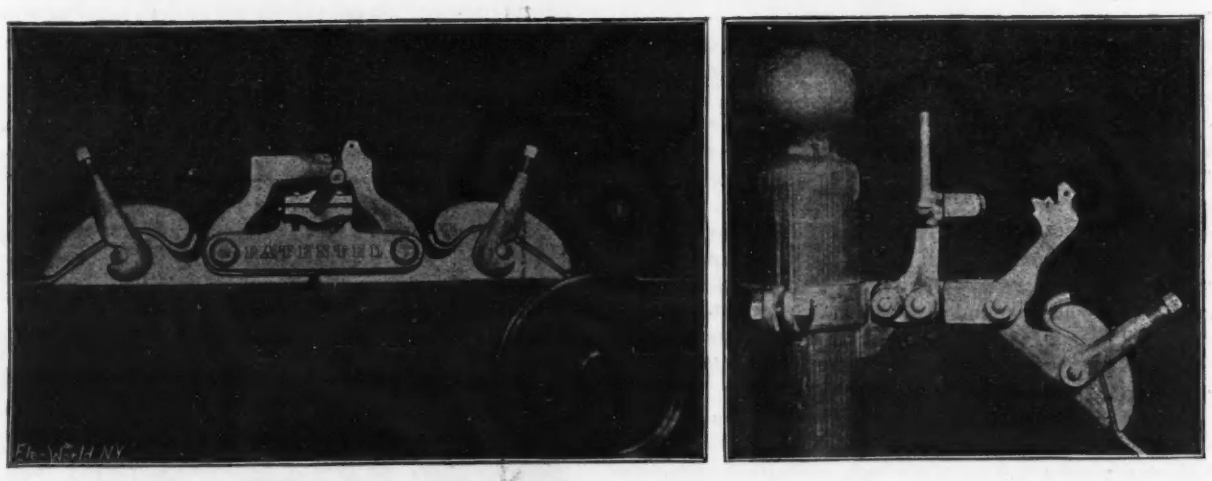
The spools of all the incandescent lighting machines are wound compound, the fine wire being inside and the coarse wire outside, the number of turns of each size wire being so adjusted as to secure perfect regulation of the machine and thus retain the voltage the same whether one light or the full number of lights are burning. The spools of the motors are mostly shunt wound, and all motors up to five-horse power have a switch on top connected to a resistance in the base for starting. Motors of 7½ h. p. and upward have a separate rheostat of a new and unique design. The resistance coils are inclosed in an iron box with slate front, on which a row of flat copper springs are mounted, which come successively into contact with a spiral-shaped drum as it is turned by a lever at the end through the space of half a circle. The spools for any of the B. C. standard machines are wound for various purposes, so a machine may easily be changed from a motor to dynamo, or vice versa, or from one voltage to another. The cap blocks of all the machines are made of slate and have heavy brass mountings for the attachment wires. The bearings are designed with reference to long continued hard work with least possible attention.

The exhibit of this enterprising company at the World's Fair, which we illustrated in our issue of May 27, has attracted wide attention, which shows that skillful design and careful workmanship are appreciated.

Trolley Safety Devices.

One of the stock objections urged by the opponents of the electric street railway is the awful effects that follow from a broken trolley wire, and the cases in which this accident has occured have been great occasions for the display of the lurid descriptive powers of the newspaper reporter; the flash at the moment of striking the ground has been magnified into perambulating balls of fire, and the public informed that their lives are in deadly peril from the awful broken trolley wires. Aside from the benefit of quieting the apprehensions of the public on this score, the matter of safety devices to do away with the damage to apparatus likely to result from grounds is of no small importance to the street railway companies, and we illustrate two forms of fittings designed to obviate the evils referred to, the invention of Carl Peterson, 1,374 Broadway, Brooklyn.

The two figures together show very clearly the operation of the devices. When a wire breaks, the release of the strain and the weight of the broken wire and overhanging part of the device itself causes the circuit to be broken, as shown in Fig. 2, or a sag unusual in amount will produce the same effect. Fig. 1 represents a trolley safety device, and Fig. 2 one for a trolley feed tap. The inventor has devised forms to meet every case met with in practice, as where lines cross at a right angle, and with a connection for the feeder tap; the latter and the method of suspension, by doing away with splicing and soldering, save much time and conduce to greater reliability.



FIGS. 1 AND 2.—TROLLEY-SAFETY DEVICES.

Among the claims are, that the trolley wheel always works on a continuous smooth surface, and there is no sparking through break of contact; and that firemen can cut the wires with impunity, and only one section of the road will be thus thrown out. The same character of devices can be used on electric light or other circuits.

The Packard Six-Candle Power Lamp.

Appreciating the demand for a small lamp for ornamental, advertising and special purposes, the New York & Ohio Company, Warren, O., the manufacturers of the well known Packard lamps, are placing upon the market something new in the 6 c. p. lamp represented by the accompanying cut. The lamp is similar in every respect to their regular commercial lamp, and has approximately the same efficiency and life. The lamp is mounted to fit any standard socket and any of the regular low voltages such as 50 or 52 volts. Where they are burned on a higher voltage they should be wired two in series. The special feature which recommends the lamp is the fact that the filament is burned at the same degree of incandescence as that of a regular lamp, thus giving a uniform life and light. The advantage of a lamp of this kind for special purposes will be appreciated by any one who has been compelled to use miniature lamps for such purposes.

The Electric Appliance Company, Chicago, are Western agents for the New York & Ohio Company, and are furnishing these lamps in the West, and are themselves giving

them a thorough test in their World's Fair exhibit, where they have over 500 burning in their illuminated lamp sign.h The effect produced by their use in this particular case gives some idea of the extensive field they will undoubtedly

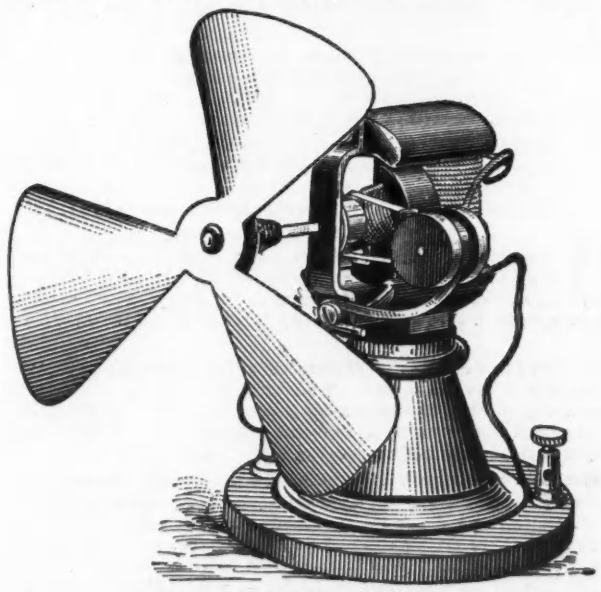
THE PACKARD SIX-CANDLE POWER LAMP.

fill as soon as their particular merits are appreciated by the trade.

The Boston Fan Motor.

The great demand for fan motors, which have come to be considered almost as much of a summer necessity as ice by the fortunate ones with an electric light service, has resulted in great improvements, and we illustrate a new type recently put on the market by the Boston Fan Motor Company, 17 Batterymarch street, Boston, Mass.

The motor, we are informed, was designed by one of the best electricians in Boston, and the fan is made of

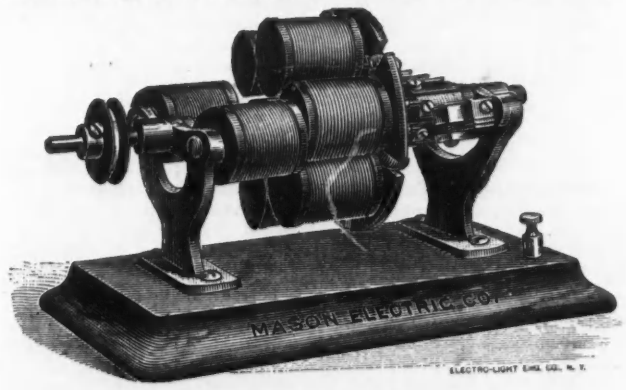


THE BOSTON FAN MOTOR.

polished aluminium. Great attention has been paid to workmanship, and it is claimed that the motor can be run much cheaper than most others.

The Mason Motor.

No labor saving machine in the world is so universally used as the sewing machine, and perhaps to-day nothing is better understood than the long train of serious and painful complaints which the constant and



THE MASON MOTOR.

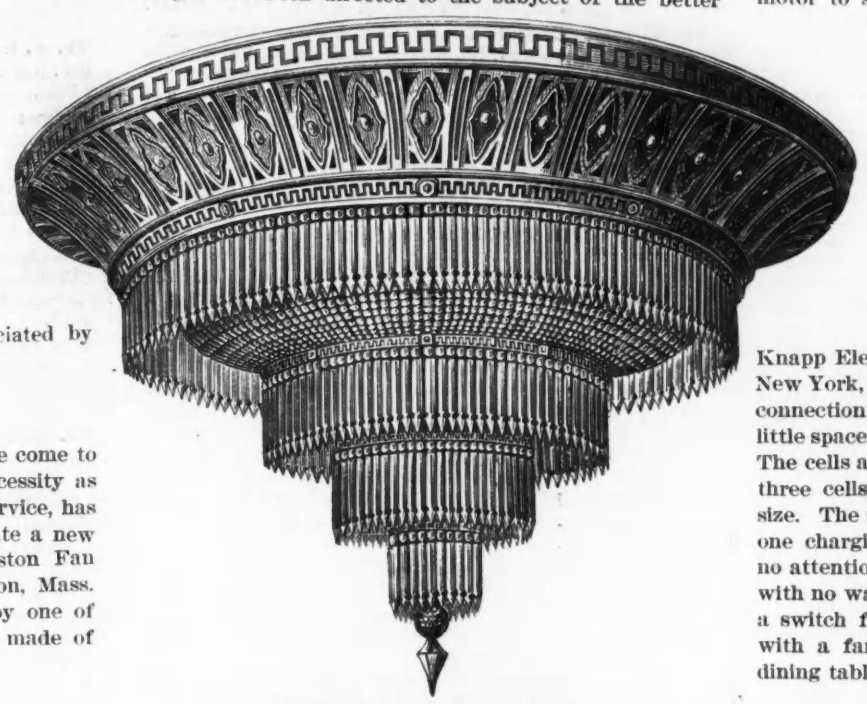
even partial use of this machine inflicts upon the female portion of the community.

As the sewing machine came in response to the growing needs of our advanced civilization, so it is inevitable that this serious objection to its use should be overcome by a mechanical contrivance which shall relieve the operator of this constant, tiresome motion, which is the cause of so much physical distress. We illustrate an electric motor designed for this purpose by the Mason Electric Company, 10 and 12 Vandewater street, New York, which, with the rheostat, is very compact in form and simple and effective in operation. It is under perfect control of the operator, the speed being instantly regulated by means of the pressure of the toes on a rheostat or regulator, or stopped entirely by pressure of the heel. Thus the operator has the use of both hands to guide the work.

A special single fluid battery is manufactured by the same firm which will run the motor for some hours without change of solution.

Electric Reflectors.

Now that the electric light has been very generally accepted as the best illuminator for churches, halls and public buildings, more attention is given to the economical and proper diffusion of the light. When first introduced all energy was concentrated on the production of the current and a perfect lamp; of late, however, thought has been directed to the subject of the better



FRINK ELECTRIC REFLECTORS.

distribution of the light, and it is found that, by the use of reflectors selected according to the requirements, an equal light is produced with less energy, and, what is better, it is evenly diffused throughout the room and not concentrated in spots, as has too often been the case, thus producing a bright light a short distance on either side of the lamp, and shadows elsewhere. With the reflector we illustrate, manufactured by I. P. Frink, 551 Pearl street, New York, the conditions are changed entirely. The light is taken from a point high enough to be above the line of vision, avoiding all glare of the direct light and evenly distributing it about the room. The reflector, as designed, has the additional advantage of being an efficient ventilator.

Columbian Adjustable Hanger.

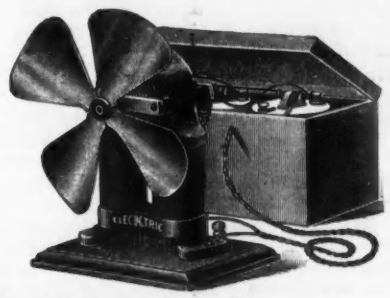
One of the great advantages of the electric light is its flexibility, permitting it to be easily changed at will to

COLUMBIAN ADJUSTABLE HANGER.

positions from which the best lighting effect may be obtained. Among the many fixtures, hangers, etc., devised to take advantage of this valuable property, those of the McCreary Specialty Company, 136 Liberty street, New York, have long been standards among electricians, and the same house has recently added another, which we show in the accompanying illustration, this last one ranking as No. 22 on their list of specialties. The adjustable hanger in question differs entirely from others on the market, containing no differential pulley, no shade roller, no spring or catches. It is simply a balanced weight divided equally on three cords so perfectly adjusted that there is no wear on the cord and there is no mechanism to get out of order. The combination is supplied complete, as shown in the engraving, and the purchaser has merely to connect the cut-out to his circuit, when it is ready for the lamp.

Knapp Ventilating Fan.

It is but natural that those who have not the advantage of an electric light circuit should demand a fan motor to sui their needs, and to meet these cases the

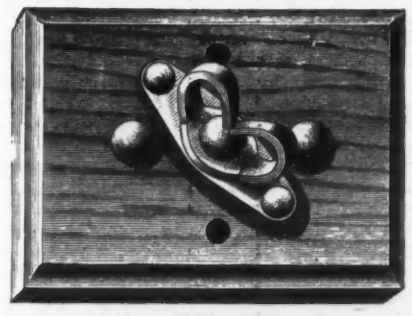


KNAPP VENTILATING FAN.

Knapp Electric and Novelty Company, 34 Warren street, New York, has designed an economical motor to be used in connection with a special primary battery, which takes up little space and furnishes current at a minimum of expense. The cells are encased in a neat cabinet, the one containing three cells being 6 inches by 9 inches by 19 inches in size. The motor can be run, it is claimed, 100 hours with one charging of the battery, which requires absolutely no attention during this time, and gives off no smell and with no waste when not in use. The motor is fitted with a switch for starting and stopping, and a special form with a fan at each end of the shaft is made for the dining table.

The Crown Two-Pole Single Switch.

The two-pole single switch shown in the accompanying illustration is manufactured by Edwards & Co., 144th St. and Fourth Ave., New York, and possesses

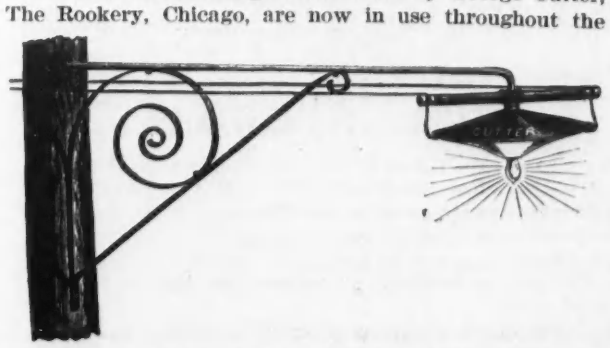


THE CROWN TWO-POLE SINGLE SWITCH.

several features of interest. The wires are securely fastened to the two fixed points, and therefore the annoyance of wires working loose is avoided—not a small matter. The ends of the switch arm are concaved to fit exactly the rounded points, making a positive contact. The switch arm connecting the two poles is held firmly in place by the spring plate underneath the base, and therefore cannot make or break the circuit accidentally.

Cutter's "Boulevard" Street Hood.

The street hoods designed and built by George Cutter, The Rookery, Chicago, are now in use throughout the



"BOULEVARD" STREET HOOD.

country and so well known as to need no further comment. However, there are cases where the goose-neck type of bracket arm is not ornamental enough to suit some tastes. This lack is met by the "Boulevard" street hood, illustrated by us, which is already beautifying many streets in Western cities.

The various details of the hood and insulating arm are worked out the same as in the now standard form of hoods made by Mr. Cutter, the departure lying in the design of the supporting bracket, which is as strong and well braced as it is neat.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

New York, June 17, 1893.

General Electric is the only one of the electrical stocks to show any activity outside of Western Union. Gossip had it at the beginning of the week that Mr. J. Pierpont Morgan, of Drexel, Morgan & Co., who has just returned from Europe, would devote considerable attention to the property. The course of the stock on Friday showed that these predictions were based on substantial grounds. The stock sold on Thursday at 70¼, but inside manipulation served to lift it on the day following to 73¾, although the price sagged off somewhat afterwards. The friends of the company professed themselves as unusually well satisfied with its present condition. The president of the company himself is given as authority for the statement that the company is earning at the rate of 20 per cent. per annum on the stock. The regular dividend of 2 per cent. on the common stock will be paid as usual Aug. 1 next, although the bears on the property have been assiduously trying to make capital of the officially denied rumor that the dividend is to be decreased or passed. On the contrary, it is stated on the authority of people reputed to be close to the management that the amount of the dividend will be in the nature of a happy surprise to the friends of the property.

Westinghouse Electric has been affected in the Boston and Pittsburgh markets by the revival of the report that the company was about to be consolidated with the big electric combine. Mr. George Westinghouse, Jr., takes occasion, however, to again flatly deny all these reports; he says no such union is in contemplation, and that he knows of no steps having been taken looking to a combination between the Westinghouse and General Electric companies. Mr. Westinghouse says he is satisfied with the business as it is. He expects his company to do a gross business this year of $20,000,000. This will enable it to more than cancel its $2,000,000 of debt. Mr. Westinghouse expresses himself as enthusiastic over the outlook for the electric business. "Its development is now only a question," he says, "of manufacturing and of manufacturing profits."

The Chicago & St. Louis Electric Railway, it is reported, is to try and have its securities listed on the New York Stock Exchange. The General Electric announce that they are to furnish all the equipment for the road, but still assert that they have absolutely no other interest in the scheme.

The Detroit Electrical Works, in pursuance of a decree of the Circuit Court of Wayne county, Mich., was sold by the sheriff on Monday last at Detroit. It was a foreclosure sale, President Hugh MacMilan buying the property in. It is, so a current report goes, to be sold to Eastern capitalists. Another story is to the effect that the General Electric Company will assume ownership. This comes from Boston and does not receive any official confirmation here.

The Western Union Telegraph Company's annual statement, presented at the dividend meeting of the board of directors on Wednesday was a disappointment, in that it showed a decrease in surplus. The statement, which is for the year ending June 30, June being partly estimated, shows: Net earnings $7,568,129, increase $169,582; interest and sinking fund $913,331, increase $2,808; net profits $6 634,798, increase $166,774; dividends $4,654,102, increase $312,464; surplus $2,002,696, decrease $155,690. From this statement it is seen that the earnings on the stock for the year have been 6.63 per cent. This compares with 6 46 per cent. on the same amount of stock for the year preceding. There was a disposition at one time on Wednesday to raid the stock on this showing, but the inactivity prevailing frustrated any such attempt. The Western Union people admit that the closing of the poolrooms in this State cost them a pile of money—by some people this loss of revenue is estimated at over $2,000,000—but they claim to have made it up pretty much in increased business in other directions. Looking at the stock market side of Western Union it is unlikely that any movement of consequence will be witnessed in this stock for some time to come. Mr. George Gould is to sail for Europe to day. He will be gone six weeks at least. He declares he is out of the stock market altogether. Mr. Russell Sage, who says, next to Mr. Gould, he is the largest individual holder of Western Union stock, doesn't speculate, and there is nobody sufficiently interested in an ownership way to influence its price.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	25	30
Detroit Electrical Works	10	2	3
East River Electric Light	100	..	65
Electric Con. & Supply Co. pref.	15	15	16
" " " " " com	15	15	17½
Edison Electric Ill., New York	100	105¼	106
" " " lsts	...	107	109
*Edison Electric Ill., Brooklyn	100	98	103
" " " Boston	100	115	130
" " " Chicago	100	220	230
" " " Philadelphia	100	120	140
Edison Electric Light of Europe	..	2	6
" Bonds	..	80	85
" Ore Milling	..	5	12
Fort Wayne Electric	..	121½	123¾
General Electric Company	100	72⅝	73
" " deb. 5's	...	81½	85
Interior Conduit and Ins. Co	100	30	40
Mount Morris Electric	..	..	65
Westinghouse Consolidated	50	24	25
" " pfd	50	45	47

* Ex. div.

AFFAIRS OF THE COMPANIES.

York, Pa.—The Edison Electric Light Company has increased its capital stock from $80,000 to $250,000.

The Edison Light and Power Company of San Francisco, Cal., has declared an eight per cent. dividend.

The American Bell Telephone Company has declared a regular quarterly dividend of $3 per share and an extra dividend of $3 per share.

The Thomson-Houston Electric Company, whose nominal corporate existence is at Middletown, has filed a statement of the condition of the company on Feb. 1, 1893, with the State Secretary. It shows capital stock actually paid in, $10,000,000; cash value of real estate, not less than $665,454.31; cash value of personal estate, exclusive of patents, not less than $5,715,691.46; amount of debts, not more than $1,835,964.21; amount of credits, not less than $5,455,818.44.

NEW INCORPORATIONS.

The People's Street Railway Company, Chester, Pa., capital stock $50,000, has been formed to construct and operate an electric railway in Chester. J. T. R. Coates, S. L. Kent and W. H. Sayen are the promoters.

The Allentown & Lehigh Valley Traction Company, Allentown, Pa., capital stock $1,500,000, has been formed to manufacture electrical apparatus. A. L. Johnson, J. K. Page and J. J. Coleman are the promoters.

The Walker & Bedford Electric Alarm Company, East St. Louis, Ill., capital stock $300,000, has been formed to make and deal in electric alarm money drawers, etc. W. J. Walker, A. L. Bedford and Emil Starek are interested.

The Lambertville Electric Light, Heat and Power Company, Lambertville, N. J., capital stock $50,000, has been formed for the purposes indicated in its title. L. H. Leber, C. Wiler, Jr., T. H. Jacobs and J. P. Allen are interested.

The Southern Passenger Railway Company, Philadelphia, Pa., capital stock $50,000, has been formed to construct and operate an electric railway in Philadelphia. F. A. Lee, Harry C. Slack and Charles R. Knowles are the interested parties.

The Tyrone Electric Street Railway Company, Tyrone, Pa., capital stock $300,000, has been formed for the purpose of constructing and operating an electric railway in Tyrone G. W. Burket, H. L. Sholly and Milton S. Falck are the promoters.

The Hartman Manufacturing Company, New York City capital stock $75,000, has been formed to manufacture and sell electric and other fixtures. E. R. Vollmer, Wm. Vollmer, Brooklyn, and Julia Hartman, of New York City, are the incorporators.

The Milford Electric Light and Power Transmission Company, Milford, Ill., capital stock $15,000, has been incorporated to build and maintain a light and power plant. H. V. Brown, E. W. Whipple and Wm. H. Mogg are the interested parties.

Shenandoah & Mahanoy City Street Railway Company, Ashland, Pa., capital stock $100,000, has been formed to build and operate an electric railway in Schuylkill county. J. F. Bailey, D. D. Phillips and McHenry Wilhelm are the interested parties.

The Monterey & Pacific Grove Street Railway and Electric Power Company, Monterey, Cal., capital stock $180,000, has been formed to build and operate a railway, etc. Dr. O. S. Trimmer, P. Oyer, M. Malarin, J. S. Matteer and Juan Malarin are the promoters.

The Fort Smith and Van Buren Electric Street Railway, Light and Power Company, Fort Smith, Ark., capital stock $100,000, has been formed to erect and operate an electric railway. W. Blair, F. T. McClure, R. L. McClure and M. N. Beaty are interested.

The Jackson Electric Railway, Light and Power Company, Jackson, Miss., capital stock $250,000, has been formed to carry on a general electric railway and power business in the city of Jackson. J. B. Harris, W. E. Hayne and J. B. Moss, all of Jackson, are the promoters.

The Golden Gate Manufacturing Company, New York, capital stock $600,000, has been formed to manufacture and sell electrical goods, etc. W. C. and Granville L. Savage, 551 West Twenty-third street, and Wilson W. Hoover, 121 Nassau street, New York City, are the incorporators.

The Caracas Electric and Power Company, Jersey City, N. J., capital stock $600,000, has been formed to erect and maintain lines of electric wire, dynamos, poles, etc. F. M. Stratton, W. E. Jennings, New York City, and R. S. Green, Jr., Elizabeth, N. J., are the incorporators.

The Miamisburg Electric Company, Miamisburg, O., capital stock $100,000, has been organized to manufacture and deal in all kinds of electrical and other machinery and appliances. T. V. Lyons, W. Gamble, C. Weber, E. Allen, A. L. Daniels, W. A. Mays and Wm. Burnley are the promoters.

The Columbia Electric Works, of Denver, Colo., has been incorporated with a capital stock of $50,000. Harry W. Lawrence, Joseph R. Knowland, Henry H. Metcalf, Charles Pierson and Thos. H. Lawrence are the interested parties. The company will purchase and sell electrical patents and do a general repairing business.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-176 Times Building, New York, June 19, 1893.

Mr. Henry G. Issertel, of the A., B. & C. Company, has returned from his wedding trip.

The Brooklyn Union Street Railway Company proposes to extend its road from Ninth avenue and Union street to Douglass street.

Mr. H. A. Cleverly, the well known electrical manufacturer of Philadelphia, stopped in the city this week, returning from a business trip to Boston.

Telephone Linemen.—It is reported that the differences of the linemen with the New York & New Jersey Telephone Company are in a fair way toward settlement.

Ajax Van Nuis, 136 Liberty street, New York City, he of the Ajax switch and Ajax lightning arrester, has returned home, having had a most successful Western trip.

Brooklyn, N. Y.—The Union Street Railway Company will hold a meeting on June 19 to take action on the proposal to increase its capital stock to $5,000,000 for improvements and extensions.

Mr. L. D. Hilles, of the firm of Bagnall & Hilles, Yokohama, Japan, is in the city, in company with his partner, Mr. A. L. Bagnall. These gentlemen will spend considerable time in the East looking up electrical matters.

Mr. Geo. W. Adams, "Happy" Adams as he is familiarly known, of the Boston Electric Protective Association, was in the city Friday of this week, on his return home from a two-weeks trip to Richmond, Va. Mr. Adams was accompanied by his wife, daughter and a young lady friend of the latter.

The Safety Insulated Wire & Cable Company, 234 West 29th street, New York City, supplied the World's Columbian Exposition with all the cables, both underground and overhead, for arc lighting, also all telephone, police and fire alarm cables in use on the grounds. The contract, which was awarded upon merit, amounted to over $200,000.

Wm. F. Bossert, of Utica, N. Y., the well known electrical and mechanical engineer, formerly the manager of the Utica Electrical and Manufacturing Company, called at the offices of The Electrical World during his recent visit to New York. Mr. Bossert has recently started in business for himself and has been very successful in his new venture.

Mr. H. A. La Chicotte, 136 Liberty street, New York City, Eastern manager of the Wrought Iron Bridge Company, of Canton, O., received the contract, June 10, for the erection of the Richmond Railway and Electric Company's (Richmond, Va.) power house. The power house, 60 × 100 feet, will be built entirely of iron, and will be located on Brown's Island, in the James River, reached by an iron bridge 180 feet in length and 16 feet wide, contract for which was also awarded the Wrought Iron Bridge Company. The completion of both power house and bridge will occur on or before Sept. 1, 1893.

The Mason Electric Company, 10 and 12 Van ewater street, New York, is a stock company recently formed under the laws of New York State, the capitalization of which is $25,000. The promoters of this company are as follows: A. Vanderwerken, president; A. Vanderwerken, Jr., treasurer; Jas. H. Mason, vice-president and manager; F. B. Johnson, secretary. The company will carry on an electric supply business, making a specialty of batteries and fan motors. Mr. Jas. H. Mason, of this company, delivered a very interesting lecture on Tuesday evening, the 13th inst., at the Dutch Reformed M. E. Church, corner Carroll street and Seventh avenue, Brooklyn, under the auspices of the P. M. M. fraternity. The subject was "Electricity a Monarch of Wonders." Mr. Mason handled the subject very cleverly and delighted the vast audience, as was evidenced by repeated encores.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., June 17, 1893.

Mr. A. L. Bagnall, of the firm of Bagnall & Hilles, Yokohama Japan, was in Boston this week looking up electrical matters in the East.

Bryant Electric Company, Bridgeport, Conn., extensive manufacturer of sockets, switches and receptacles for all systems, reports business excellent.

The Samson Cordage Company is receiving many orders for its Samson braided cord. This is extensively used for hanging arc lamps, covering field magnets, and for trolley cord.

Jewell Dynamo Belting is recommended by the Jewell Belting Company, of Hartford, Conn., as being the best composition for keeping belts soft and pliable and resisting the effects of mineral oil.

The Dean Steam Pump Company, Holyoke, Mass., manufacturer of steam pumps for every service, claims that the Dean independent condenser attached to any engine will save from 20 to 40 per cent. of steam.

Mr. Don C. Watters, manager of the Lake Girard system of mica mines, states that they have recently added a grinding department to their business and are now ready to ship ground mica in any desired quantity.

The Stirling company, through its New England agent, Mr. J. Bradford Sargent, has sold to the Portland Street Railway Company 250 h. p. of boilers. Mr. Sargent is figuring on several large contracts for Stirling boilers.

The Massachusetts Chemical Company, Boston, Mass., will shortly make its first shipment in quantities for the foreign trade. It has made very desirable foreign connections, and has the assurance that its trade in Insulac will be very large.

The New England Pottery Company, No. 146 Condor street, East Boston, Mass., manufacturers of battery cups of all sizes from 1⅛ in. diameter by 3 in. high to 7 × 9½, reports business brisk. Special shapes in quantities are made to order.

The National India Rubber Company, Bristol, R. I., well known manufacturers of insulated wires and cables, reports a very satisfactory Western trade. Its trade in the East is of such a nature that the company is a couple of months behind with present orders.

The American Electric Company, manufacturer of the "New Era" electric gas lighter, has found that its lighter has created such a demand that it was deemed necessary to move into larger quarters. This the company intends to do in the near future.

The Brown & Sharpe Manufacturing Company, Providence, shows its growth probably better by the number of its employés during the last 36 years than in any other way. In 1857 they employed 20 men, while at present there are no less than 1,000 employed in this pushing Providence house.

The Massachussets Electrical Engineering Company, Boston, Mass., which makes a special business of expert examinations, testing and expert superintendence, is doing considerably work in this line, having recently had the supervision of the large plants of the Haverhill & Lawrence Street Railway Company.

The Schuyler Electric Company, Middletown, Conn., is receiving many orders for the Knowles arc lamp, some of the advantages of which are its absolutely steady, white light. Besides being noiseless in operation, it is adapted for constant potential and alternate circuits.

The Sessions Foundry Company, Bristol, Conn., is probably the largest manufacturer of iron castings for electrical purposes in New England. It casts dynamo magnets of a special mixture of iron that, it is claimed, gives much better electrical results than ordinary castings. It runs constantly large cupolas melting about 40 tons daily.

The Pratt & Whitney Company, of Hartford, reports an active demand for the holder with inserted cutters for lathes, for turning, cutting off, threading, shaping and boring metals, which it manufactures. The cutters may be sharpened by grinding without changing their form. This company also manufactures taps dies and milling cutters, which are carried in stock in variety.

PITTSBURGH NOTES.

June 17, 1893.

The municipal lighting plant of the city of Allegheny is contemplating a large extension and improvement of its lines and stations. All the light towers, of which the city used to have about 50, have been taken down, and they have been superseded by a number of mast arm lights. Mr. David S. Hunter, the superintendent of the plant, has made his station one of the models of municipal lighting stations in the country.

A consolidation of the Pittsburgh, Allegheny & Manchester Traction Company, the Federal Street & Pleasant Valley Passenger Railway Company and the Allegheny Traction Company was effected yesterday. These different street railway companies comprise the entire system of street railways in Allegheny City. The project of consolidating all these roads has been under consideration for years, but for some reason or other terms satisfactory to all the parties concerned could never be arrived at until now. The consummation of this plan, however, will be of great benefit to the companies themselves, to the stockholders and, from the fact that the operation of the lines can be much improved on account of the consolidation, it is hoped that the public will also be greatly benefited. The capital stock of the new corporation is to be $5,000,000. All of the roads, except the Allegheny Traction Company's line, are operated by electricity. The lines of these roads cover the city of Allegheny like a network for many miles, and all of them have a terminus in the city of Pittsburgh.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 MONADNOCK BUILDING, CHICAGO, June 17, 1893.

G. E. Greene, publisher of *Electricity*, was a Chicago visitor during the week.

W. H. Eckert, of the Gray Telautograph Company, has been spending some time at the Exposition.

Gilbert E. Wilkes, engineer of the Detroit Electric Works, was an interested spectator in Electricity Building at the Fair during the week.

T. D. Lockwood, of telephone fame, passed through Chicago last week on his way to the Railway Telegraphers' convention being held at Milwaukee, Wis.

L. E. Marple, formerly editor of *The Street Railway Gazette*, has left Chicago for Montreal, where he will connect himself with the growing electrical interests of that city.

A. Mitchell Hall, manager of the C. & C. Electric Motor Company, of New York, is in Chicago. The exhibit of his company at the Fair is about complete and attracting great attention.

The Chicago Motor Company have placed on the market their new fan motors, a good stock of which they have on hand to supply the great rush of orders. Their address is 313 South Canal street.

"Jim" Godfrey, of the New York Insulated Wire Company, has arrived at the Exposition and will personally look after the finishing of his exhibit. This he promises to have in order in a few days.

Dilworth Richardson, of St. Paul, has returned to the Fair to look after the interests of the American Heating Company in person. Mr. Richardson will make his exhibit in Electricity Building headquarters during the Fair.

The Pumpelly-Sorley Storage Battery Company, of 166 South Clinton street, now have their factory in good working order for the manufacture of their new battery. Orders for this battery are coming in faster than the company can handle them. They expect to soon start a much larger plant.

"Pop" Fuller, as he was popularly known throughout the West, who had been connected with Edison interests from the earliest times, having recently severed his connection with the General Electric Company, left Chicago last week for Worcester, Mass. He is now with the Washburn & Moen Company.

Messrs. Cutler & Hammer, of 313 South Canal street, who have recently placed on the market a very clever switch, find their capacity for work tested to the utmost to keep up with orders. Their switch has met with popular favor, as it should, because of its many points of excellence. They will soon have a handsome board fitted up and in position at the Fair.

News of the Week.

THE ELECTRIC LIGHT.

Rome, N. Y., is talking of a municipal plant.

Norway, Mich., will be lighted by electricity.

Bement, Ill., is soon to have an electric light plant.

Millvale, Penn., has voted $80,000 for a municipal plant.

Higginsville, Ill., has voted $17,000 for an electric light plant.

Ripon, Wis.—It is proposed to put in an electric lighting plant.

Wenatchee, Wash.—M. E. Schinn has been granted a franchise for an electric plant.

Sing Sing, N. Y.—The Board of Trustees have decided to call for new bids for lighting the streets.

La Junita, Colo.—Plans and arrangements have been perfected for the new electric light plant.

Jellico, Tenn.—The question of lighting the city by electricity will soon be brought before the authorities.

Wenonah, Pa.—The town clerk states that an electric plant for lighting the streets is under consideration.

Tipton, Ia.—A franchise has been granted to F. W. Adams and others for supplying the town with electricity.

Geneseo, N. Y.—A special meeting will be held June 24, to vote in the matter of electric lighting for the streets here.

Charleroi, Pa., will vote soon in the matter of a bond issue which will include $25,000 for an electric lighting plant.

Batavia, N. Y.—A special election has been called for June 26, to vote on a bond issue of $26,000 for an electric lighting plant.

Jamaica, L. I., N. Y.—At a meeting of the Town Board a resolution was passed to advertise for bids for lighting the streets of Woodhaven.

Hart, Mich., has given an exclusive franchise for 15 years to the Gurney Milling Company.

Dexterville, N. Y.—The Consumers' Arc Light and Power Company has been formed to utilize the water power here. Chas. H. Jones and O. E. Jones will give details.

Berkley, Va.—The Berkley & South Norfolk Water and Electric Light Company have petitioned the council for authority to equip and operate an electric lighting plant.

Jamaica, L. I.—At a meeting of the town board a resolution was passed to advertise for bids for lighting the streets of Woodhaven, as per form of contract to be had from Clerk of the Jamaica Town Board.

Tiffin, O.—Sealed proposals will be received until July 7 for the lighting of streets and alleys of the city for a period of five years with electric lights of 2,000 c. p. each, and said lights to burn all night and every night of the year. Jeremiah Rex, city clerk.

THE ELECTRIC RAILWAY.

Newton Centre, Mass.—A new street railway is proposed to Boston.

Rhinebeck, N. Y., and Rhinecliff are agitating for an electric railway.

The Peoria and Pekin (Ill.) electric railway companies have combined their interests.

Amsterdam, N. Y.—An electric road is talked of to pass through Akin to Johnstown and Gloversville.

Jacksonville, Fla.—The Jacksonville Street Railway Company will change its motive power to electricity.

Conshohocken, Pa., has granted electric railway privileges to the Montgomery County Passenger Railway Company.

Aurora, Ill.—The Frazier Road Cart Company will be equipped with electric motors, and receive its power from the street railway company.

The Brooklyn, Bath & West End Railroad has obtained permission to substitute electricity for steam in New Utrecht and Gravesend.

Johnstown, N. Y.—A franchise has been granted to the Cayadutta Electric Railroad Company to build and operate an electric street railway here.

The Beverly & Danvers (Mass.) Electric Railway is to be run by storage batteries and will be controlled, it is said, by Lynn and Boston companies.

Denver, Colo.—The capital stock of the Tramway Company is to be increased. Rodney Curtis is president. Bids are now being prepared for building and plant.

Jamestown, N. Y.—The Jamestown Street Railway Company has applied for right of way for extension of its line to the line between Jamestown and Ellicott.

Luzerne, Pa.—The Luzerne, Dallas & Harvey's Lake Railway Company has been granted permission to operate an electric street railway in the borough of Luzerne, Pa.

Cohoes, N. Y.—The West End Improvement Company has been organized by the citizens of the Fifth Ward, and they will build and operate a belt line around the city.

Oneida, N. Y.—The Board of Village Trustees have granted permission to the Oneida Street Railway Company to change its motive power from horses to storage battery or trolley.

Frederick, Md.—The Frederick & Middleton Electric Railway has elected Lorne E. Downs as president, and E. L. Miller as secretary, and will at once begin the work of construction.

Muncie, Ind.—George Reed and James Pixley are interested in an electric railway scheme to reach from that city to Eaton, a distance of eight miles, and build a line to the fair grounds.

Hoosick Falls, N. Y.—The Hoosick Railway Company is to build a four-mile electric road to Walloomsac; $60,000. S. D. Locke, Jos. Buckley and Wm. Holmes, of Hoosick Falls, are interested.

Middletown, N. Y.—The Middletown-Goshen Traction Company is to operate a street railway here, about 10 miles long; $100,000. B. F. Low and A. D. Seaman, of Middletown, are interested.

Potsdam, N. Y.—The Racket River Railway Company is to build a 20-mile road from here to Colton, to be operated by steam or electric power. A. L. Chatterton, of 28 Maiden lane, New York, will give details.

Freeport, Ill.—Freeport has secured subscription for $20,000 worth of stock for their new electric street railway. The new system will be adopted and the old horse car line will be changed to an electric line.

Buffalo, N. Y.—Louis F. W. Arend, of Buffalo, is president, and W. A. Philpott, of Niagara Falls, is vice-president of the proposed company which will build an electric road between Youngstown and Lewiston, to carry both freight and passengers.

Hamilton, Ont.—The Radical Electric Railway Company, of Hamilton, Ont., has decided to get the power for operating its plant from the new works at Niagara Falls, and has let a contract for wiring, etc., necessary to convey the power from Niagara to Hamilton.

St. Joseph, Mo.—Master in Chancery M. M. Crandall is making his final settlement of the affairs of the People's Street Railway and Electric Light and Power Company. The street railway property will be turned over to the St. Joseph Traction Company, of which James T. Gardiner, Albany, N. Y., is president. New cars will be purchased and the old motors will be replaced with improved ones.

PERSONAL NOTES.

Lieutenant Manning K. Eyre, of the U. S. Navy, has accepted a responsible position in the incandescent lamp department of the General Electric Company.

Mr. R. A. Fessenden has resigned his position at Purdue University to take charge of the course in electrical engineering which the Western University of Pennsylvania has decided to introduce. Mr. Fessenden, both from an electrical and educational standpoint, is well qualified for this work.

Mr. H. M. Haines, the well known railroad representative who has accompanied so many of the special trains carrying delegates of the National Electric Light Association to its various conventions, has accepted the office of treasurer of the American Traveler and Transit Company, 849 Broadway, New York City, which conducts a general railroad, steamboat and steamship business.

MISCELLANEOUS NOTES.

Springfield, O.—Warder, Bushnell & Glessner, makers of agricultural implements, are considering the advisability of equipping their plant with electric power.

Canal Trolley Boat.—The Superintendent of Public Works states that all experiments on electric power for the canals will have to be borne by the inventors themselves.

Cleveland, O.—The King Bridge Company will erect a fireproof riveting shop and run the machinery by electric power. The company is on the market for electric equipment.

Electric Buoys.—A system of electric light buoys is being placed from Chicago harbor to the World's Fair. There will be 26 a half mile apart, each surmounted by a 100-c. p. lamp.

The Electrical Fire Insurance Rules of the Underwriters' International Electric Association have already been adopted by nearly all of the Underwriters' associations of the United States.

De Pere, Wis.—The De Pere Lumber and Fuel Company has decided to build a planing mill. The building will be 40 × 80 feet, and the mill will be run by electricity. Operations will be commenced in a few days.

Fairhaven, Vt.—The Drake & Stratton Co. has taken the contract to build a large power house for Jas. R. Langdon, vice-president of the Central Vermont Railway Company, to generate electricity to the extent of 2,000 h. p., to be used to operate the quarries in the vicinity.

The Westinghouse Charges.—Governor Pattison, of Pennsylvania, has issued a requisition on the Governor of New York for the delivery into the custody of Pennsylvania of Charles H. Clark and Wm. H. Hamilton, employés of the General Electric Company, indicted in Pittsburgh for conspiracy against the Westinghouse company.

Power Station.—The Drake & Stratton company has taken a contract to build a large power house at Fair Haven, Vt., for James R. Langdon, vice-president of the Central Vermont Railroad company. The station will be equipped to generate electricity to the extent of 2,000 horse power, which will be used to operate the marble quarries in the vicinity.

Electric Launches.—Messrs. O. C. and A. W. Hartman, of Duluth, Minn., have purchased an electric launch from the Columbian Launch Company. The boat is 32 feet long and will carry about 30; when charged, the boat will run about 60 to 80 miles at about 10 miles an hour. Geo. W. Kneass, of San Francisco, has made for Mr. F. W. Swanton, Santa Cruz, a 30-foot electric; the battery consists of 44 River and Rail cells. The Mexican government has given an order for two similar launches.

Frank Aldrich, general manager of the Hanson Battery, Light and Power Company, of Washington, D. C., has decamped, leaving, it is said, numerous debts unpaid. The company forfeited its charter May 1 for non-payment of State license fee of $60. Mr. Aldrich's lack of executive or financial ability is thought to be the cause of the trouble. The Domestic Electric Power and Light Company, H. S. Barbour, president, has been recently organized and has bought the entire patent rights under which the Hanson company was doing business.

Trade and Industrial Notes.

The Berlin Iron Bridge Company, of East Berlin, Conn., is putting up a new foundry for the Watts-Campbell Co., at Newark, N. J.

"Micanite," for the sale of which Messrs. Eugene Munsell & Co., 218 Water street, New York City, are the agents, continues to grow in favor and demand.

The Wrought Iron Bridge Company, of Canton, O., have issued neatly printed catalogues containing illustrations of several bridges, power-houses, etc., recently erected by them.

The New York Electrical and Development Company 251 William street, of which Mr. E. S. Boggs is manager, has entered largely, and with success, upon the manufacture of patented electrical apparatus.

The Sperry Electric Railway Company, Cleveland, O., has sent out a very neat little pamphlet illustrating and describing its well known electric railway system and containing a number of valuable tables for the use of engineers and practical men.

The Belknap Motor Company, Portland, Me., has issued a little folder calling attention to the Standard dynamos and motors and commutators which it manufactures, and giving a number of testimonials from those who have had these machines installed.

The Waddell-Entz Company, 203 Broadway, New York City, have in operation, in the Manufactures Building, World's Fair, Chicago, a 10-h. p. slow speed generator. The order for this generator was received by the Waddell-Entz company solely upon its merits and efficiency.

George d'Infreville has removed to 10 Desbrosses street, New York city, where he will continue the manufacture of his well known wasteless zincs. That the zinc is really a great advance over other forms is shown by the increase in orders, and the steady demand from those who have once tried it.

Waite & Bartlett, of 143 E. Twenty-third street, New York, show in their fine exhibit at the World's Fair the largest Holtz static machine of their manufacture in the world. This firm has become justly celebrated for the excellent character of their apparatus and the conscientious character of their dealings.

The Ansonia Electrical Supply Company, formerly the Electrical Supply Company, of Chicago, has recently issued a little circular describing the Wirt dimming switch, a very convenient piece of apparatus for turning down incandescent lights. This company also closed a contract recently for 40 miles of Shield Brand wire for lighting and power work.

Queen & Company, Incorporated, Philadelphia, Pa., report large sales of magnetic vane ammeters and voltmeters, which contain qualities highly essential for switchboard use, and make them especially valuable in isolated plants. A number have been supplied to exhibiting companies for installation at the World's Fair, and the makers have a handsome collection in their own display. The Acme portable testing set is also meeting with much favor.

The Electric Heat Alarm Company, 113 Devonshire street, Boston, has issued a new catalogue describing and illustrating the numerous ways in which its heat alarm apparatus may be applied. One of the great advantages claimed for the system is that it is the only automatic one for hotels calling attention in the office to the room in which the fire may be located. An interesting application is to detect hot bearings. Several buildings in Haverhill are now being equipped and estimates made for a large number of others elsewhere.

The General Incandescent Arc Light Company, First avenue and Thirty-third and Thirty-fourth streets, New York, has issued a handsome catalogue of its arc lamp, entitled catalogue No. 1, which supersedes circulars Nos. 1 and 2 hitherto devoted to the same use. Owing to the great beauty of the design of many of the lamps the catalogue has almost the character of an art publication. To those who have not followed the advance of the last several years in the design of ornamental arc lamps this little book will be a revelation.

The Franklin Electric Company, Cincinnati, O., will in a few days organize into a stock company, with a capital stock of $10,000, with P. A. H. Franklin, president; H. J. Miles, secretary and treasurer; Edwin B. Stephens, manager. They will manufacture electrical specialties, are dealers in electrical supplies and contractors for electrical work of every description. They will also give considerable attention to armature repairing and buying second-hand dynamos and motors of all kinds and have located their office and workshop at 184 Elm street.

The Carter-Guy Electric Company has succeeded the Electrical Construction and the Maintenance Company, Edwin C. Carter, proprietor, which has so successfully conducted the electrical business for three years at 125 Fifth avenue, Pittsburgh, Pa. The business will be conducted under the active management of Mr. Carter and Mr. H. Guy, who for a number of years was with the H. C. Frick Coke Company, and who will have charge of the financial affairs of the Carter-Guy Company. This company has secured the sole agency for Allegheny County for the well known Perret motors.

The Electrical Engineering and Supply Company, of 134 East Sixth street, St. Paul, Minn., will by July 1 have removed all of its stock and business to 249 Second avenue, South, Minneapolis, Minn., when the name will be shortened for convenience to the Electrical Engineering Company. The new quarters will be much larger than the present ones, and will furnish factory facilities for the Northwestern Packard Lamp Company, whose entire output (a capacity for at least 1,000 lamps per day) will be handled exclusively by the Electrical Engineering Company.

I. P. Frink, 551 Pearl street, New York, makes a specialty of designing electric and other reflectors to order to secure the best distribution of light when the purposes and dimensions of a hall, church, theatre or other large building are given. We illustrate

elsewhere one of the many designs manufactured by this house and which have been largely sold, not only in America, but abroad. Among recent buildings supplied are 35 prominent churches in various parts of the country; the Gallery of Fine Arts, World's Fair, the State House of Columbus, O.; the Chicago Art Institute; Convention Hall, Saratoga, and other large buildings.

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OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

UNITED STATES PATENTS ISSUED JUNE 13, 1893.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

499,253. Process of Magnetic Separation and Apparatus Therefor; Richard H. Sanders and Chas. T. Thompson, Philadelphia, Pa. Application filed Dec. 27, 1892. The combination of a magnet having an overhanging, elongated, polarized surface, a shield arranged along each side of said surface, a feeding device arranged to deliver stock to the upper end of said surface, and separate receptacles for gangue and ore, subjacent respectively to the upper and lower ends of said surface. (See illustration.)

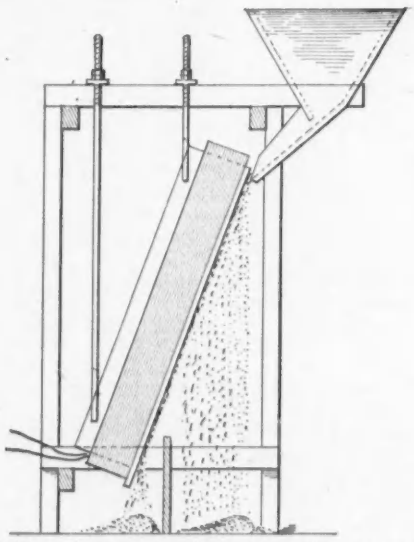
499,254. Electric Hose Coupling; Howard Sargent, Cambridge, Mass. Application filed Feb. 21, 1893. In an electric hose or pipe coupling, the combination of the half with the shoulder having a hole through it, the plug of insulating material contained in said hole also having a hole through it, the electric wire, metallic cap, and spring connecting said cap with the wire and all contained in the hole in the plug, the half reamed out at the end, the flanged ring of insulating material, and the metallic flanged ring secured to the ring and wire secured to said metallic ring.

499,261. Burglar Alarm System; Alfred Stromberg, Chicago, Ill. Application filed Feb. 11, 1893. In a burglar alarm protection, the combination with a roller made up of two metal tubes insulated from each other, a flexible covering mounted upon said roller, a circuit carried by said covering, each of two terminals whereof is attached to one of the said metal tubes.

499,270. Safety Support for Trolley Wires; Hiram K. Whitner, Chicago, Ill. Application filed Feb. 6, 1893. In an overhead system for electric railways, the combination with a conductor and two guard wires of a support frame, a suspension cable, a section of netting adapted to be secured to said guard wire and cable.

499,275. Safety Device for Systems of Distribution; Herbert C. Wirt, Boston, Mass. Application filed March 16, 1892. An alternating current generator having its generating coils arranged in any ordinary manner, and connected at an intermediate point between the circuit terminals to a collecting ring or brush by which such coils are grounded.

499,277. Method of and Apparatus for Uniting Metals; John H. Bassler, Myerstown, Pa. Application filed Dec. 1, 1892. A method of uniting metals, which consists in first coating the materials to be united with a layer of carbon, then placing a fillet of aluminium or aluminium alloy in the joint, and finally passing an alternating current of electricity through the materials and through the fillet transversely of the joint and until the fillet is fused.



No. 499,253.—Process of Magnetic Separation and Apparatus Therefor.

499,297. Electric Gas Lighting Apparatus; Thomas W. Lane, Boston, Mass., and Charles E. Lee, Chicago, Ill. Application filed Feb. 8, 1892. In an electric hand lighting gas burner, the combination of the burner, fixed electrode, two-armed lever controlling the gas cock and carrying an electrode, the pawl spring and a catch adapted to co-operate with said pawl spring to hold the gas cock open, coiled spring for holding the cock normally closed.

499,298. Electric Gas Lighting Apparatus; Thomas W. Lane, Boston, Mass. Application filed Feb. 15, 1892. In an electric hand lighting gas burner, an electrode carrying arm combined with an oscillating gas cock having near its base a cam piece or segment, and a pawl for oscillating said gas cock and electrode.

499,305. Electric Bell; John Lea Moore, New York. Application filed June 6, 1892. A stamped cup-shaped bell hammer, in combination with an electric bell, and having its supporting arm made in a single piece.

499,313. Electrical Measuring Instrument; Edward Weston, Newark, N. J. Application filed Oct. 3, 1892. In an electrical measuring instrument, an index actuated by the working parts thereof, a shell of magnetic material inclosing said working parts and having a slot or opening through which said index protrudes, and a box or case inclosing the protruding part of said index.

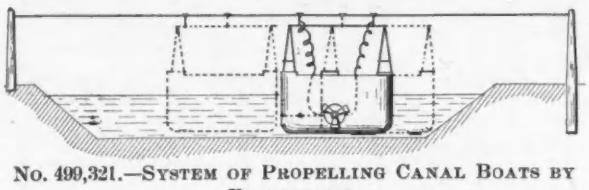
499,321. System of Propelling Canal Boats by Electricity; Samuel W. Gear, Buffalo, N. Y. Application filed Jan. 26, 1893. In an electrical system of canal boat propulsion, a power wire and a return wire supported over the waterway and arranged to be shifted laterally in accordance with the lateral movement of the boat. (See illustration.)

499,350. Commutator for Dynamo-Electric Machines; Horace F. Parshall, Lynn, Mass. Application filed Jan. 13, 1893. A commutator segment comprising a base portion of one metal and a contact portion of another better conducting metal dovetailed thereto.

499,363. Electric Switch; James F. McElroy, Albany, N. Y. Application filed Nov. 16, 1892. In an electric switch, a cylinder composed of a series of discs constructed of a non-conducting substance, a spindle upon which said cylinder is mounted, a metallic plug placed in one or more of said discs, a means for connecting said metallic plug or plugs with an electric heater together with a means for connecting said metallic plug or plugs with the poles of a battery.

499,374. Conduit Electric Railway; William R. De Voe, Shreveport, La. Application filed Oct. 28, 1892. An underground conduit having a slotted cover, sections of said cover being movable and having a hinged connection with the conduit, combined with a line conductor supported in the conduit its entire length except at those portions which have the movable sections of the slotted cover.

499,411. Electric Signaling Apparatus for Elevators; Chas. G. Armstrong, Chicago, Ill. Application filed Jan. 23, 1893. A signaling apparatus for elevators comprising signaling devices visible outside of the shaft at the several doorways of the same, means operated by the elevator, making the signaling devices at each floor operative only when the elevator is approaching that floor, and means for actuating said signaling devices.



No. 499,321.—System of Propelling Canal Boats by Electricity.

499,424. Strong Current Indicator; Charles D. Haskins, Brooklyn, N. Y. Application filed Sept. 9, 1890. The combination with a spring fixed at one end, of a contact point against which the free end of said spring tends to press due to the resiliency of said spring, said spring being provided with a projecting arm at a short distance from the fixed end, the length of said arm being small compared to the length of the spring, an expansible wire included in an electric circuit, and having one end fixed and the other end attached to the end of said projecting arm, said wire being adapted to normally hold the free end of said spring away from a contact point by bending the spring at a point between the fixed end and said projecting arm, whereby when an abnormal current passes through said wire it is elongated to permit the free end of the spring to make a contact with said contact point due to the resiliency of the spring.

499,428. Electric Hinge; William S. Hull, Sheffield, Ala. Application filed Nov. 16, 1892. A hinge having an insulated pintle provided with an annular groove and a contact spring resting in the grove.

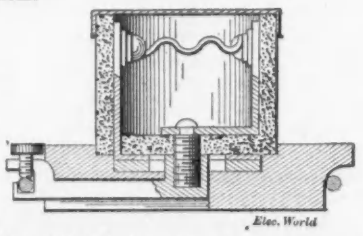
499,446. Alternating Current Generator; William Stanly, Jr., and John F. Kelly, Pittsfield, Mass. Application filed Jan. 9, 1892. The combination with the stationary annular magnetic element or part of the generator, the induced coils on the polar extensions and the energizing coil between such extensions, of the rotary core having two corresponding rows of poles the faces of which are cut down so that their clearance is increased from their centres to their edges or sides.

499,461. Overhead Trolley Wire Switch; Rudolph M. Hunter, Philadelphia, Pa. Application filed Feb. 2, 1893. In an electric railway, the combination of a main line and branching tracks, a continuous suspended main conductor, a switch structure formed of parts clamped to the said main suspended conductor and forming an upward gap transverse to the length of the said main conductor and also provided with an obliquely arranged lateral projection and a suspended branching conductor connecting with the end of the said oblique projection of the switch.

499,473. Electric Light; Gaston Sautter, Paris, France. Application filed Jan. 5, 1892. A reflecting lamp with carbons, casing, the reflector having an aperture with a spyglass at same, a second spyglass arranged under the carbons and at right angles to the first and extending through the casing, and a screen for the latter spyglass, whereby the front and rear faces diverge from each other from the centre to the upper and lower portions of the reflector.

499,485. Relay Fuse Block; Gardner T. Voorhees, Boston, Mass. Application filed Aug. 23, 1892. A continuous flexible fuse, a movable carrier supporting the fuse throughout its length, and terminals in electrical contact with intermediate points thereof.

499,497. Cut-Out; Patrick J. Barrett, Boston, Mass. Application filed April 3, 1893. A cut-out comprising an attaching plate or base, a circular block of insulating material secured to the face of the base and provided with a central aperture, a circular series of conductors extending from the inner face of said block parallel with its central aperture and exposed at its periphery, a central pole or conductor extending through the said central aperture, fusible wires connecting the inner end of the central pole with the inner ends of said series of conductors, and a conducting casing inclosing and turning upon the periphery of said block and provided with a spring on its inner side to contact with any one of said circular series of conductors, said casing and central pole being adapted to have the circuit wires connected to them.



Elec. World

No. 499,664.—Electric Fuse Block.

499,518. Method of Electrically Welding Metals; Charles L. Coffin, Detroit, Mich. Application filed Sept. 25, 1890. The process of electric welding, which consists in electrically heating a short section of material, heating the extremities of the articles to be welded by pressing the ends of the same against the short heated section and then completing the weld.

499,519. Apparatus for Punching Metal; Charles L. Coffin, Detroit, Mich. Application filed Feb. 28, 1893. The mode of punching and heating metal consisting in simultaneously punching a hole and electrically heating the point at which the next hole is to be punched.

499,543. Electro-Magnetic Car Brake; John C. Henry, Westfield, N. J. Application filed Aug. 8, 1892. An electric train brake, comprising a dynamo on each car, a magnetic clutch connected with said dynamo, and a drum operated by said clutch.

499,544. Regulator for Electric Machines; John C. Henry, Westfield, N. J. Application filed Sept. 3, 1892. The combination with a dynamo-electric machine having a movable brush-holder, of a disc of diamagnetic metal rotating with the armature shaft, a U-shaped electromagnet having its poles embrace the edge of the disc and hinged at its lower end, and an arm rigidly attached to said magnet and connected with the brushholder. (See illustration.)

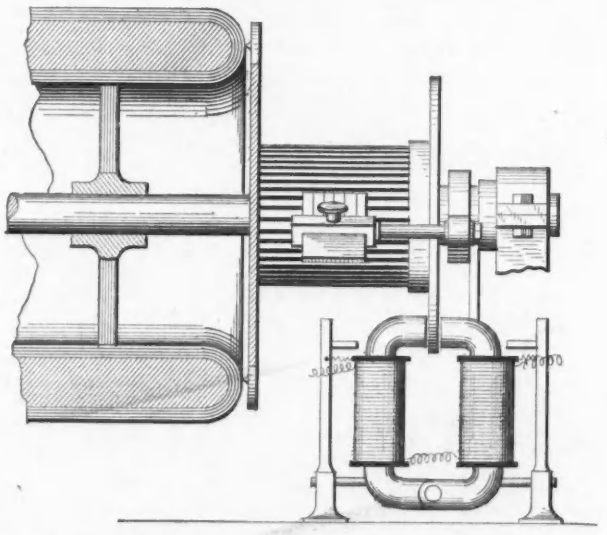
499,596. Electric Igniting Device; William H. Russell and George E. Russell, Jersey City, N. J. Application filed March 9, 1893. As a new article, a combined cigar cutter and lighting device, consisting of a burner, of electrical contact terminals placed in proximity to the burner, a lever to one arm of which one of said terminals is secured, an extinguisher actuated by the lever so as to clear the burner when the lighting contact is made and to extinguish the flame when the lever is returned, a cutter secured at the other arm of the lever and a plate having an insertion opening, past which said cutter moves as the lever is actuated.

499,610. Recorder; John T. Todd, Newman, Ill. Application filed May 24, 1893. The combination with the force wheel having two ratchet wheels provided with oppositely projecting teeth, of armatures controlled from the force or agent being recorded, oppositely projecting armature levers, each provided at its outer end with a pivoted and rigidly secured pawl, the rigid pawl of lever engaging the same ratchet as the pivoted pawl of the opposite lever.

499,614. Multiple Fuse Block; Gardner T. Voorhees, Boston, Mass. Application filed Sept. 1, 1892. A fuse carrier composed of incombustible, non-conducting material, and a fuse imbedded therein with its upper surface exposed throughout its length, combined with terminal contacts independent of said carrier and adapted to be brought into contact with different parts of the fuse.

499,646. Switch; George W. Russell, Denver, Colo. Application filed April 7, 1893. In a circuit switch, the combination with the circuit of a rocking lever, a double coil spring having its extremities attached to a stationary support above the lever fulcrum and its centre attached to the lever below its fulcrum, and suitable contacts.

499,657. Method of and Apparatus for Electrically Welding Sheet Metal; Charles L. Coffin, Detroit, Mich. Application filed Oct. 18, 1892. In a machine for electrically welding metal, the combination with a base, of an arm carried thereon, a mandrel supported on said base parallel with said arm, conductors hinged to the base and adapted to clamp the material to be welded against said mandrel and connected with one terminal of a source of electric energy, a traversing carriage on said arm, an insulated conductor carried on said carriage connected with the other terminal of a source of electricity, and a pressure roller carried on said carriage.



No. 499,544.—Regulator for Electric Machines.

499,662. Trolley Wire Hanger; Charles B. Elliott, Boston, Mass. Application filed Aug. 8, 1892. In an insulating hanger, the shell with its reduced tubular extension and the member inclosed therein with its threaded stem protruding, in combination with the insulating material filling said shell, interposed between it and the hanger and surrounding said tubular extension.

499,664. Electric Fuse Block; Thomas J. Fay, New York, N. Y. Application filed Feb. 11, 1891. A cut-out device for electric circuits consisting of a block or base provided with a metallic piece having a threaded socket at one end and a binding post at the other, said block also provided with a flat contact ring concentric with said threaded socket, all in combination with a cup having a flat contact ring on its bottom adapted to make contact with said ring, and a threaded contact plug projecting through the bottom of the cup and fitting said screw-threaded socket, and a fusible strip inside of said cup, one end being electrically connected with the ring and the other end similarly connected with the plug. (See illustration.)

499,676. Electric Arc Lamp; Rudolph M. Hunter, Philadelphia, Pa. Application filed March 28, 1893. In an arc lamp, the combination of two fixed carbon holders, a vertically movable and rotatable rod carrying two movable carbon holders, feeding devices for feeding the rod vertically, and mechanical devices for rotating the rod upon raising it, whereby the two sets of carbon may be successively burned and regulated by a single regulator and feeding device.

499,681. Electro-Magnetic Blanket; Nils A. Renstrom, Omaha, Neb. Application filed April 15, 1893. The wire coil having at its respective ends the battery connections combined with the intermeshing ribbons or connections, and a suitable cover or casing.

499,693. System of Wiring Multiple Switchboards; Chas. H. Wilson, Chicago, Ill. Application filed Oct. 8, 1892. The combination with a band or group of cables run behind a switchboard in curves to afford slack between different corresponding subdivisions of switches upon the different sections of the board, of supports for said band or group consisting of a horizontal row of pins inserted in pipes, said pipes being supported or sustained independent of the portion of the board carrying the switches.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886 *—can be had for* 25 *cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.*

In This Issue: The Western Electric Company at the World's Fair.

THE ELECTRICAL WORLD

AN ILLUSTRATED WEEKLY REVIEW of CURRENT Progress in Electricity AND ITS PRACTICAL APPLICATIONS

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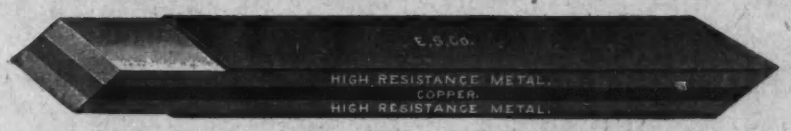

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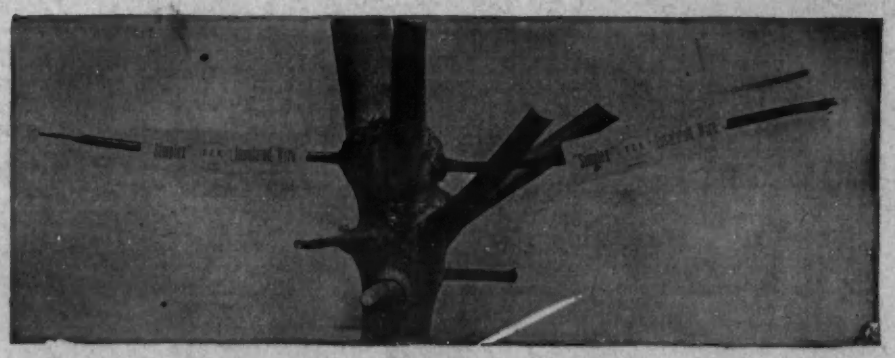

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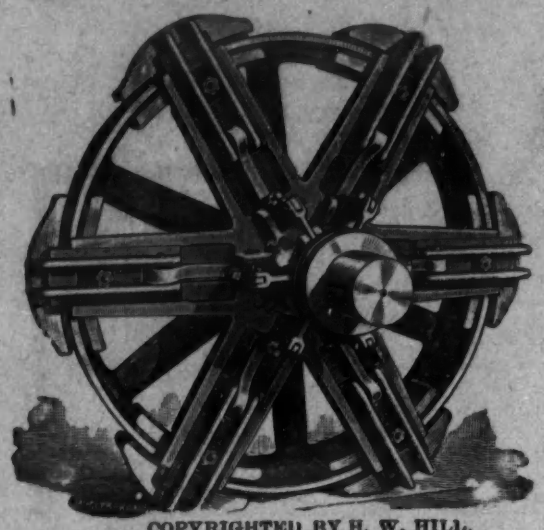

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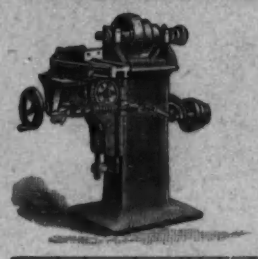

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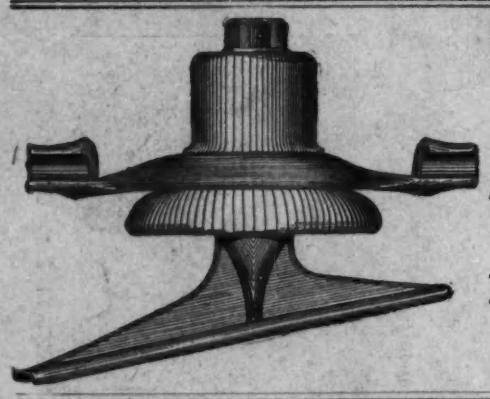

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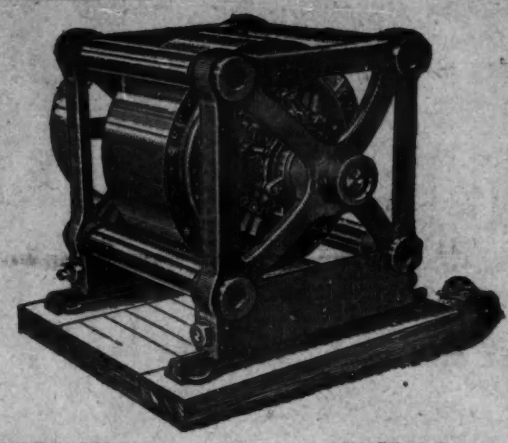

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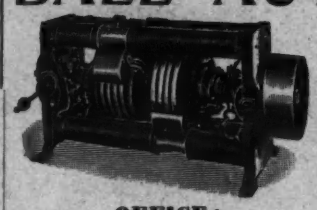

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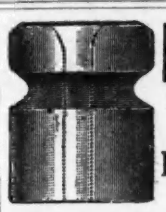

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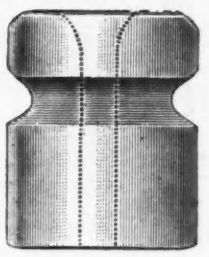

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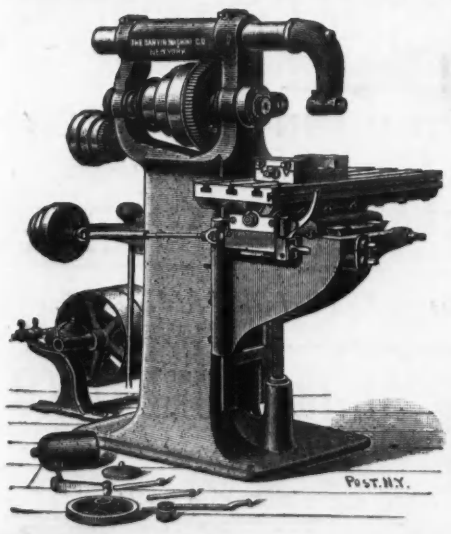

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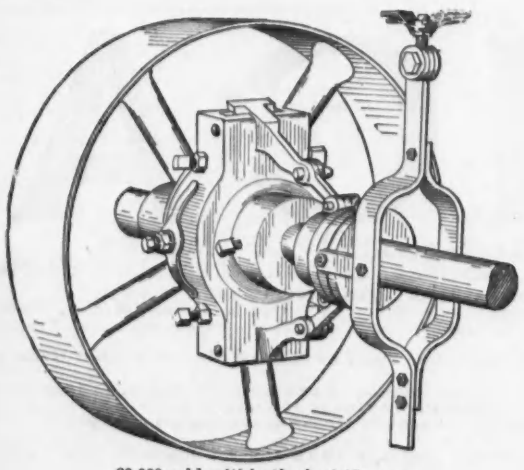

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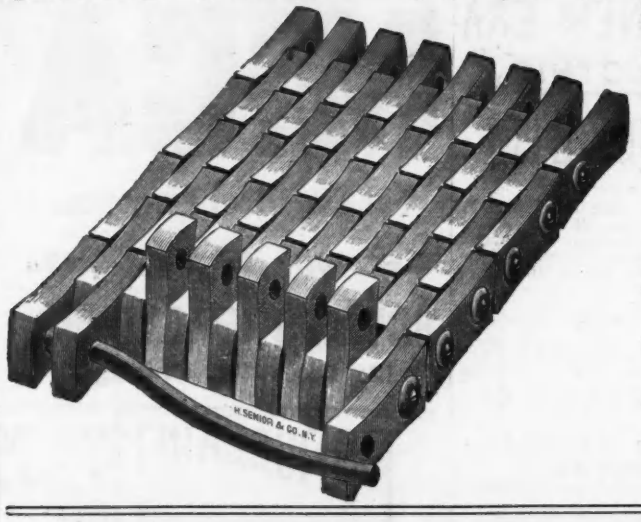

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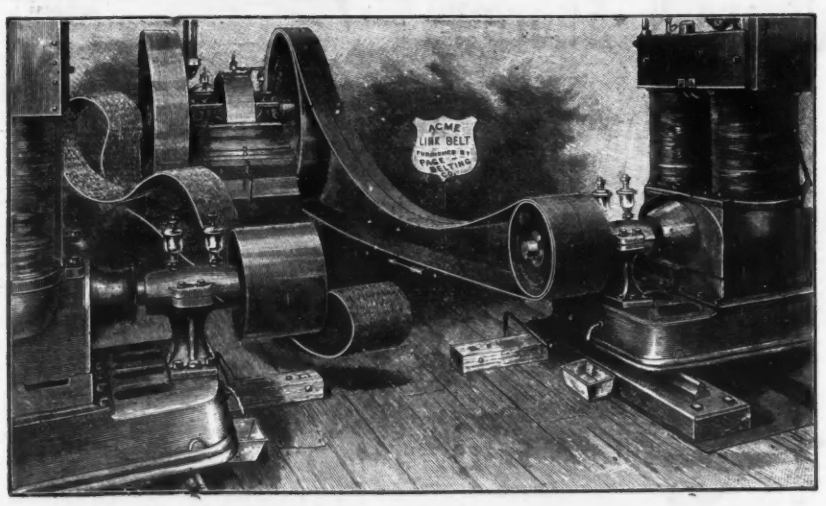

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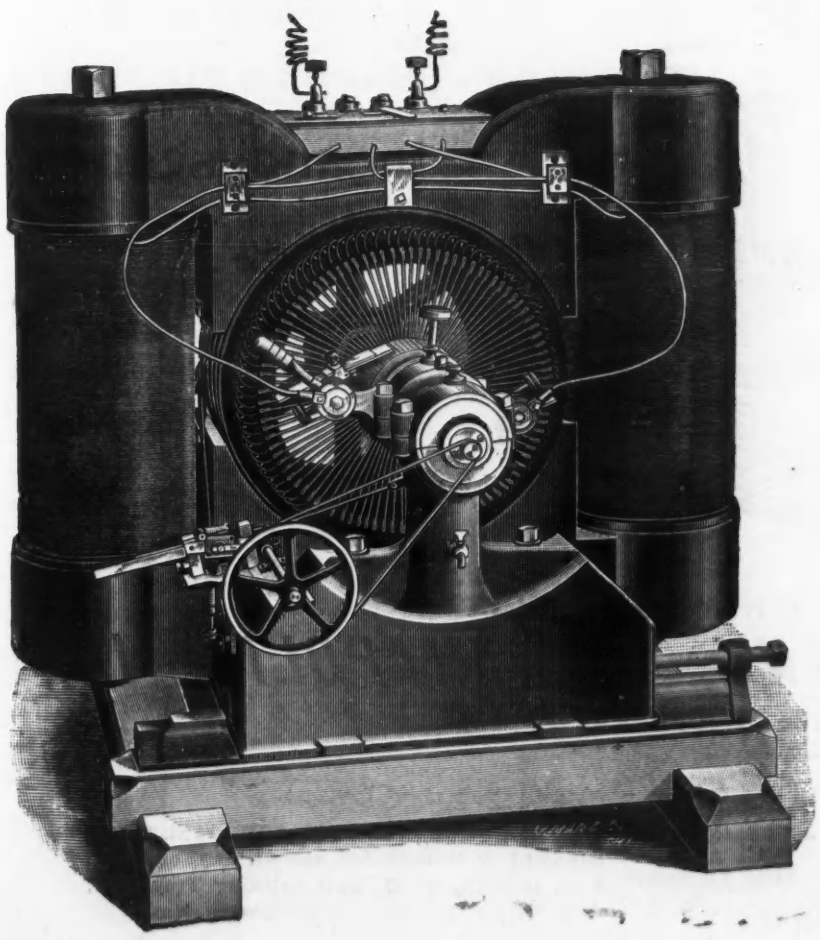

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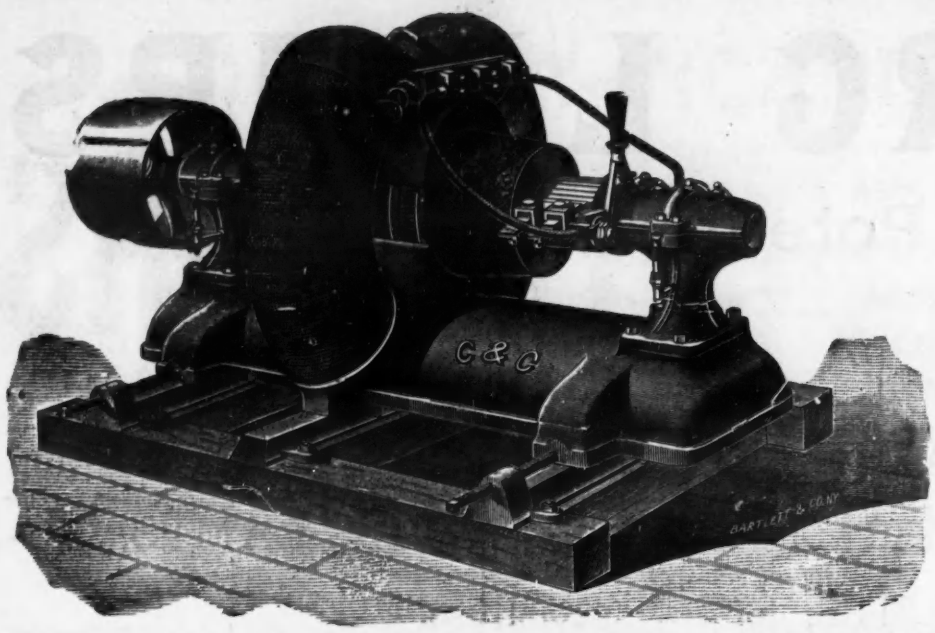

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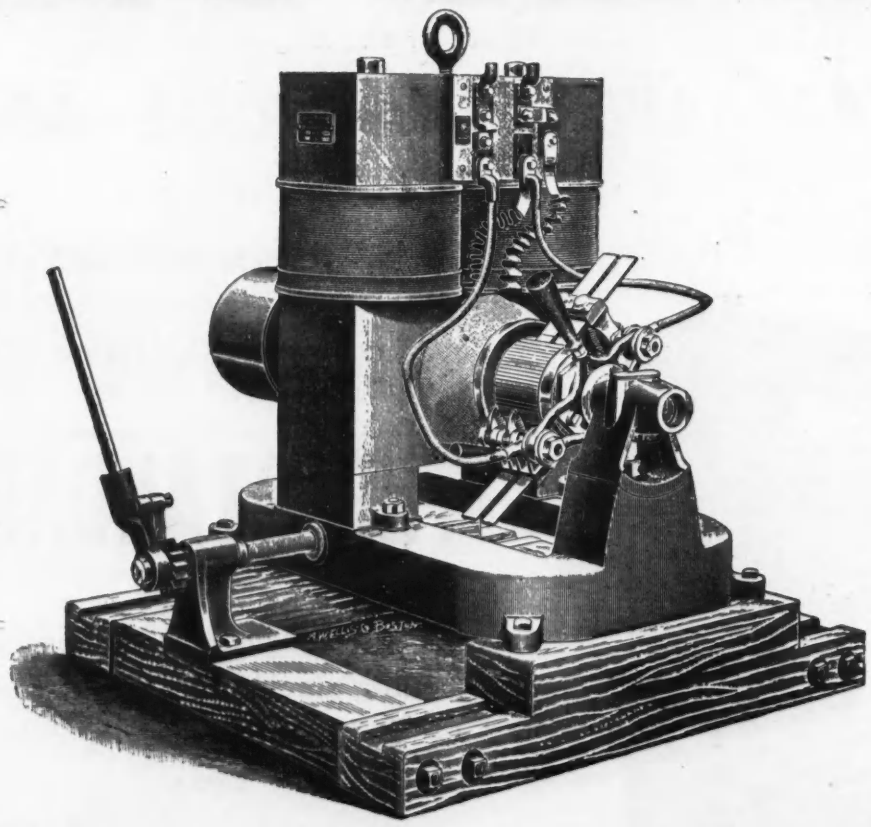

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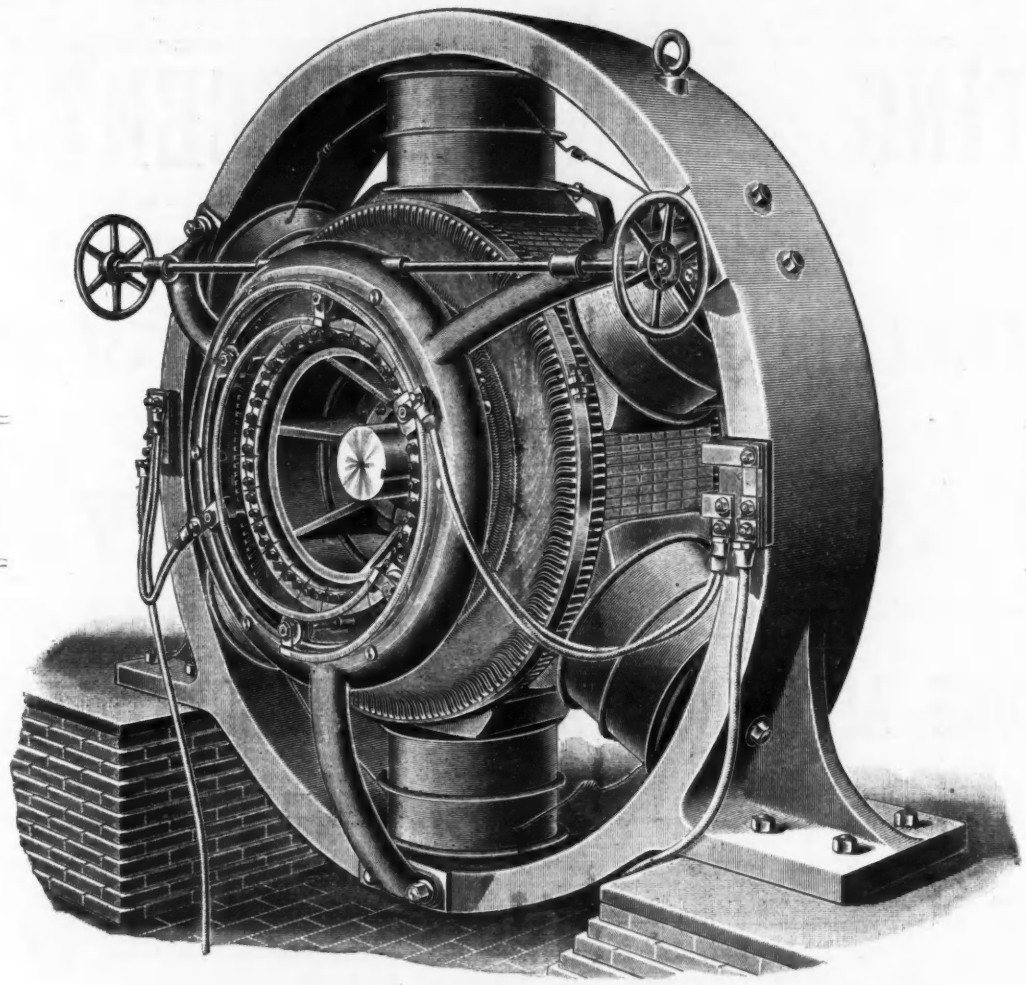

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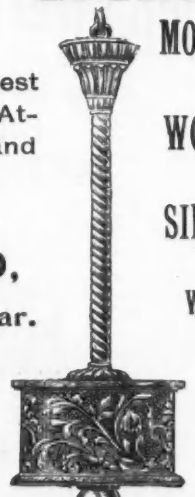

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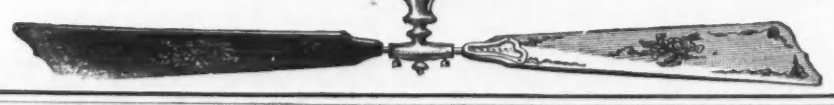

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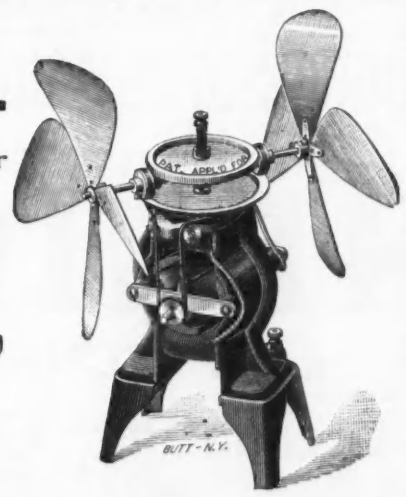

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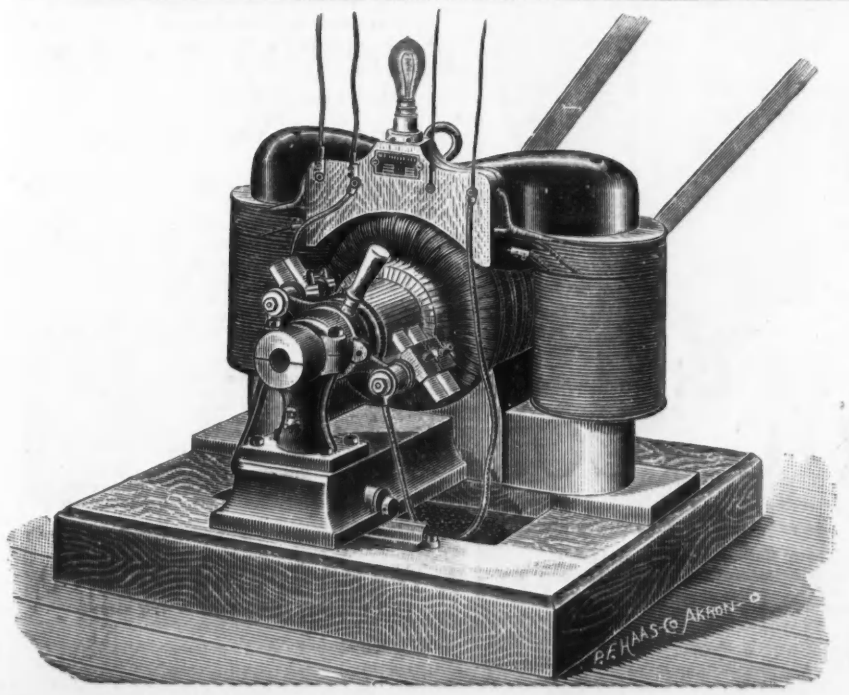

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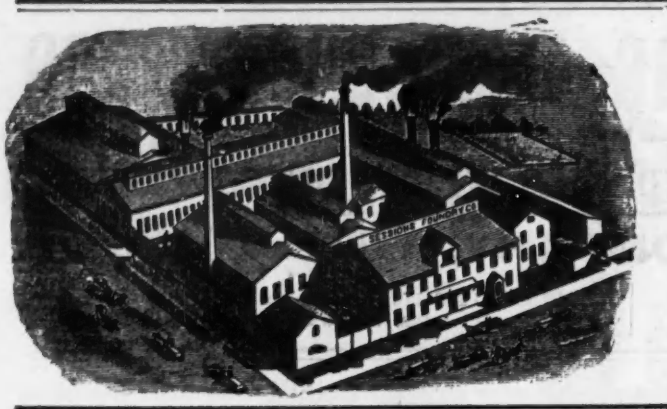

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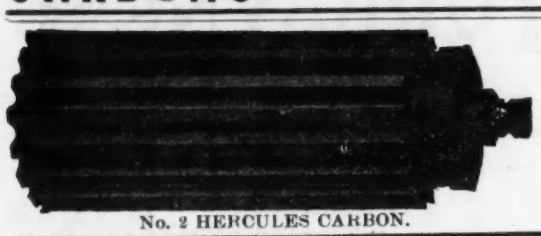

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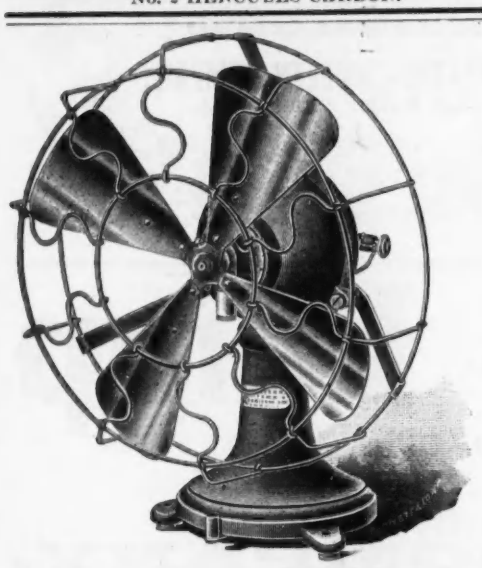

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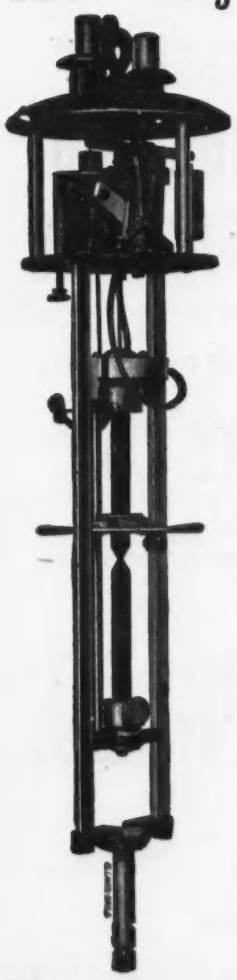

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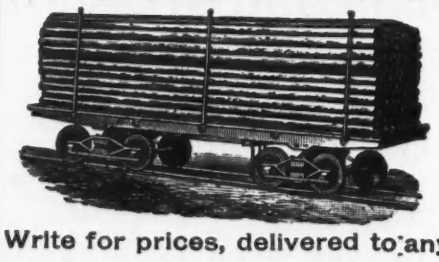

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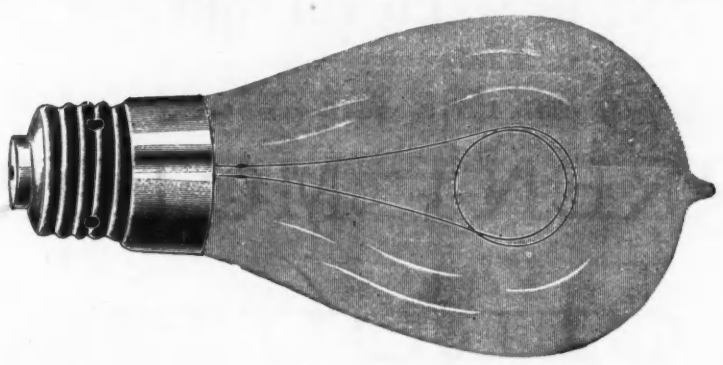

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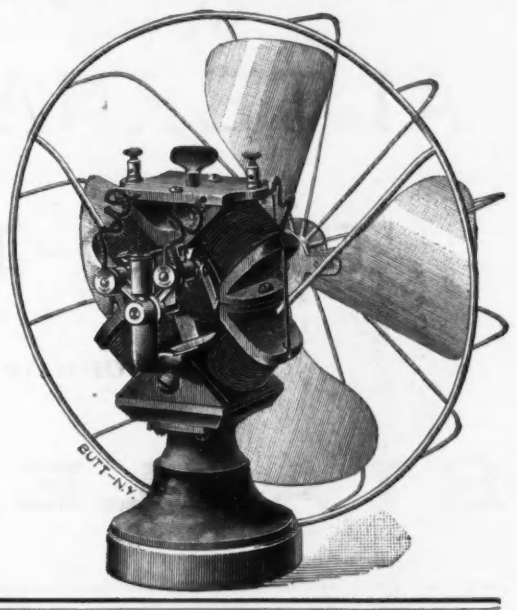

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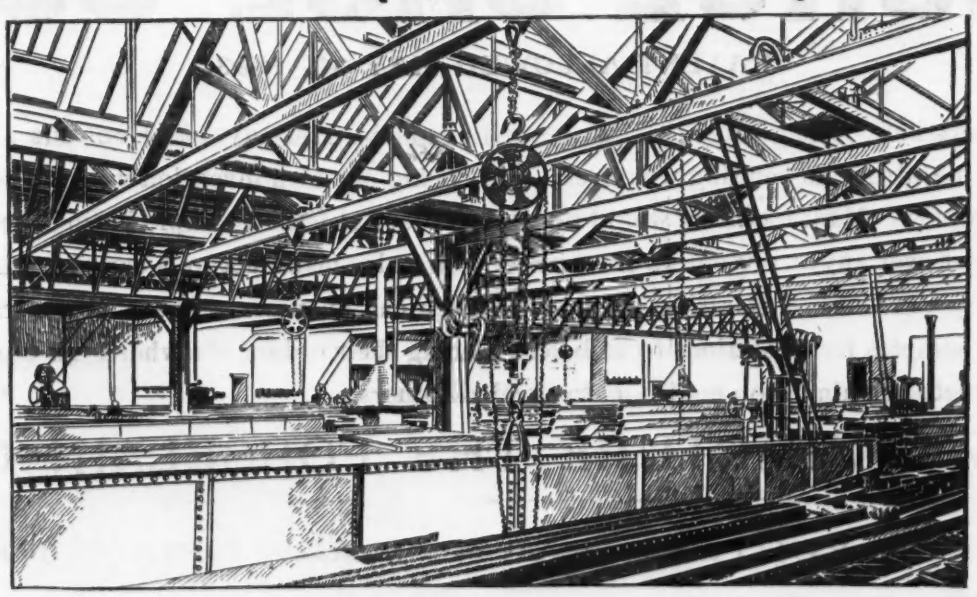

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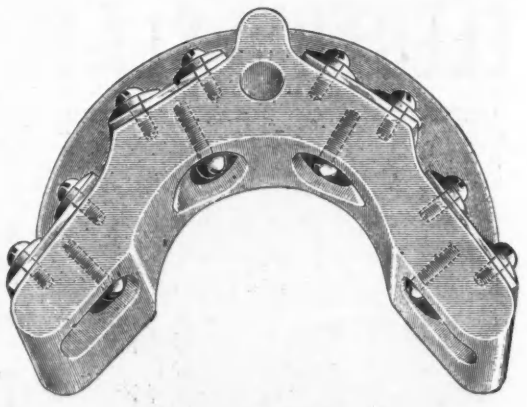

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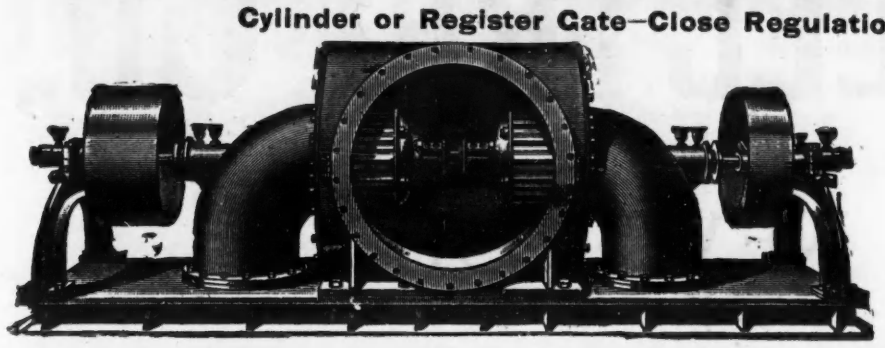

The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high speed and great efficiency and large capacity** for its **diameter,** being **double the power** of most wheels of the same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent. of useful effect **guaranteed.**

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Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft, with cast-iron Flume, Draft Tubes, End Bearings for Shaft and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs, on horizontal shafts, and where the situation admits of their use we recommend them.

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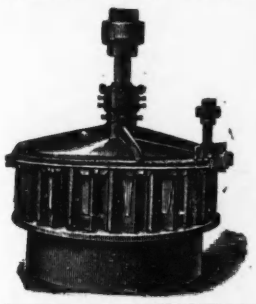

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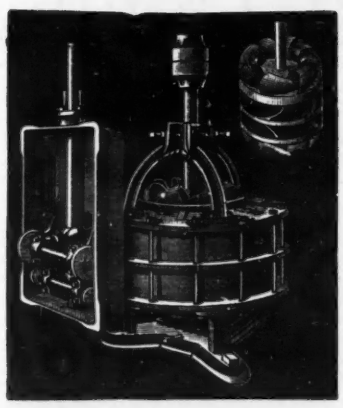

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The gates being always tight, and never out of order, make them the most economical wheel when running.

They have a strong, steady movement, start easily, and are easy to regulate.

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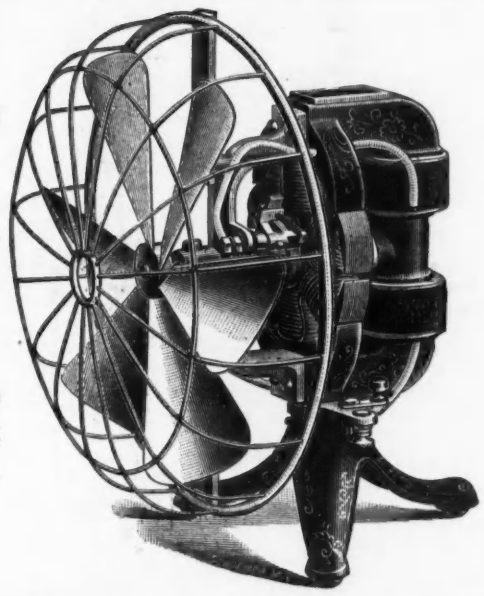

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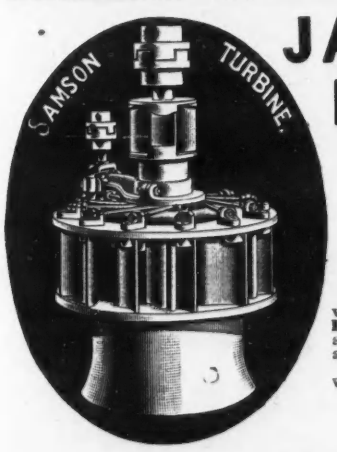

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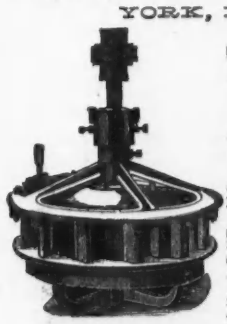

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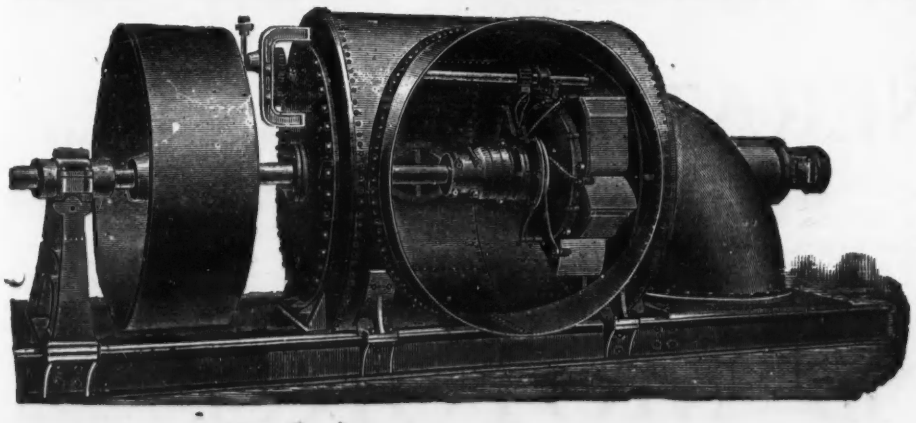

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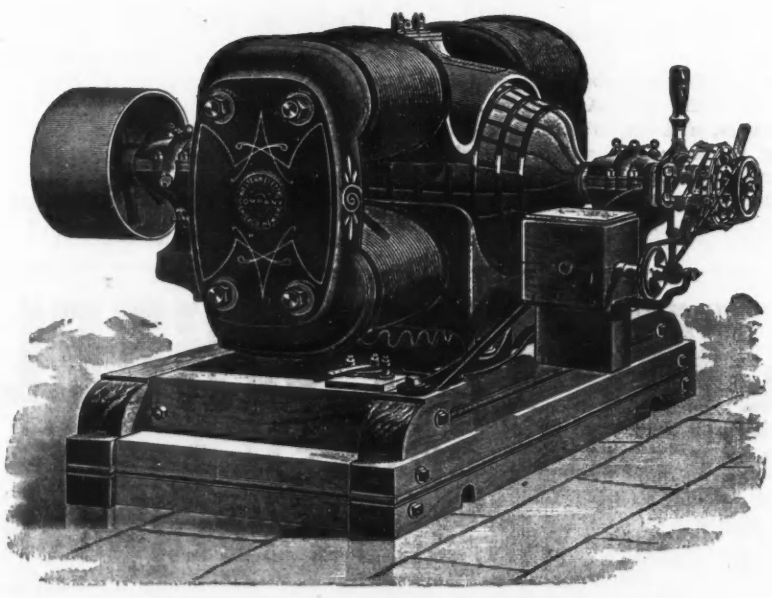

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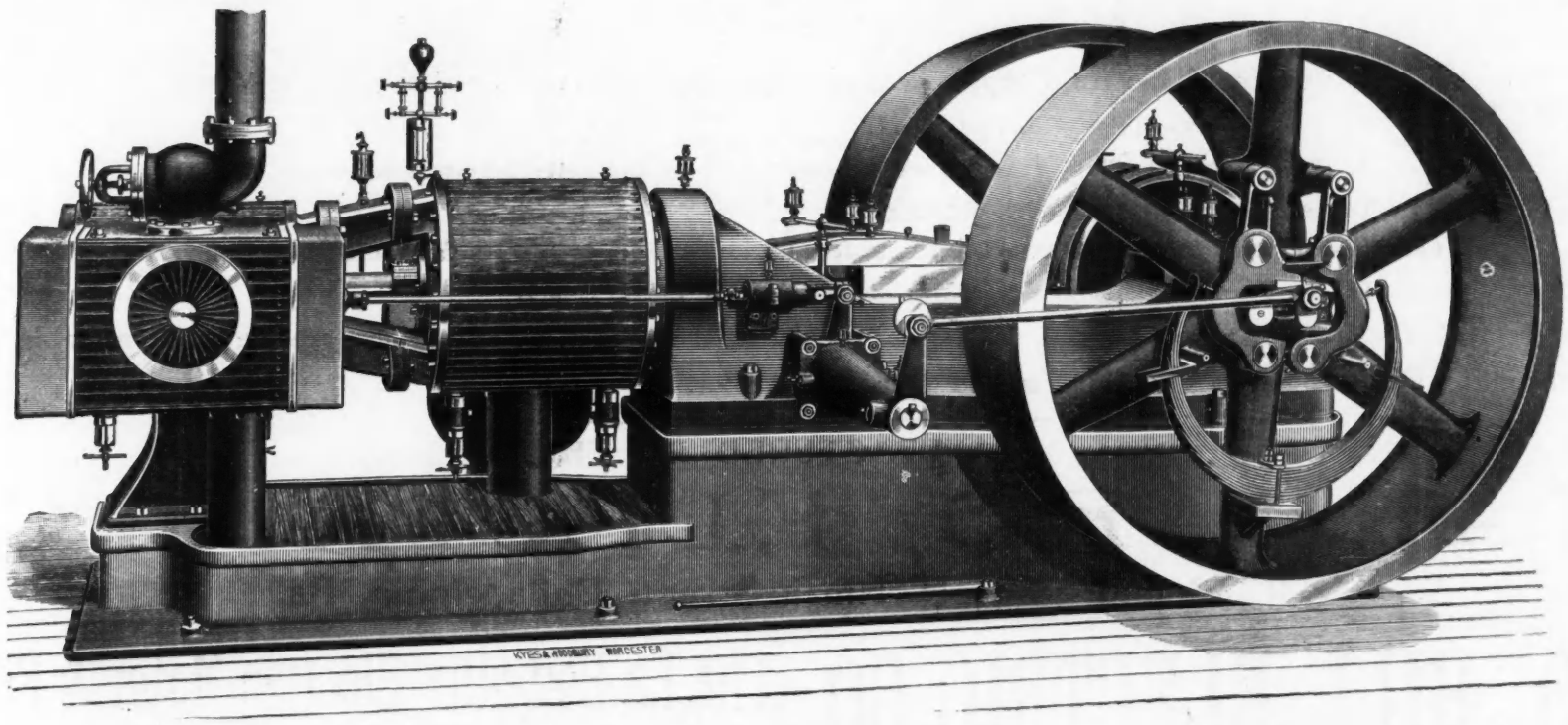

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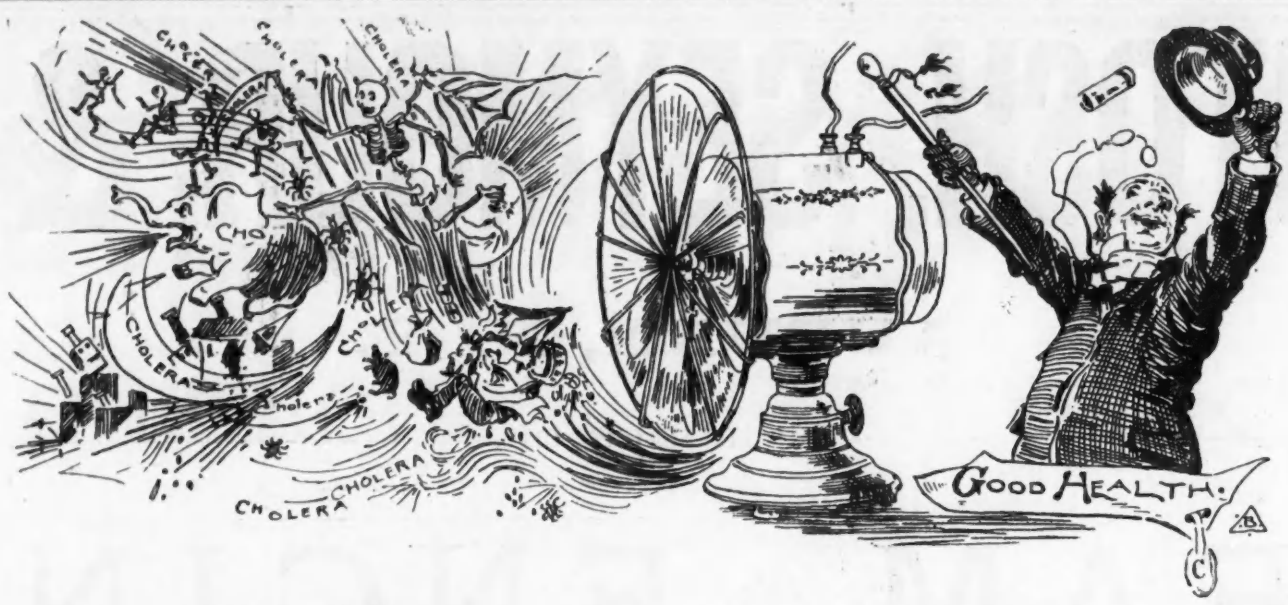

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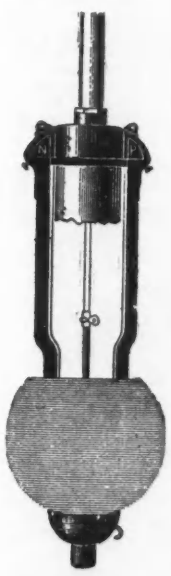

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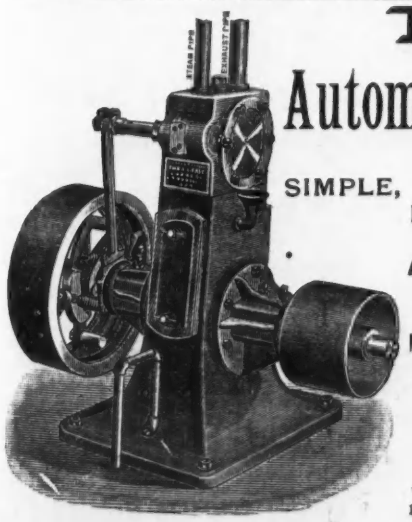

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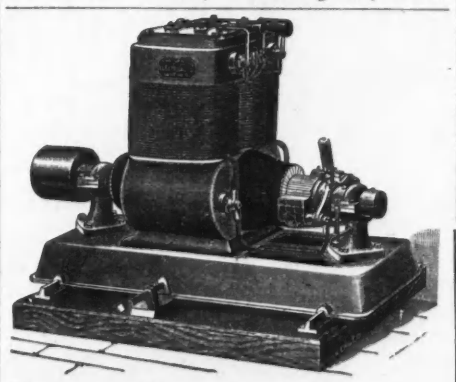

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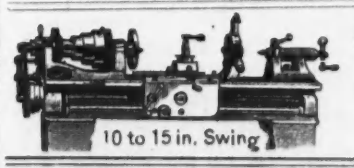

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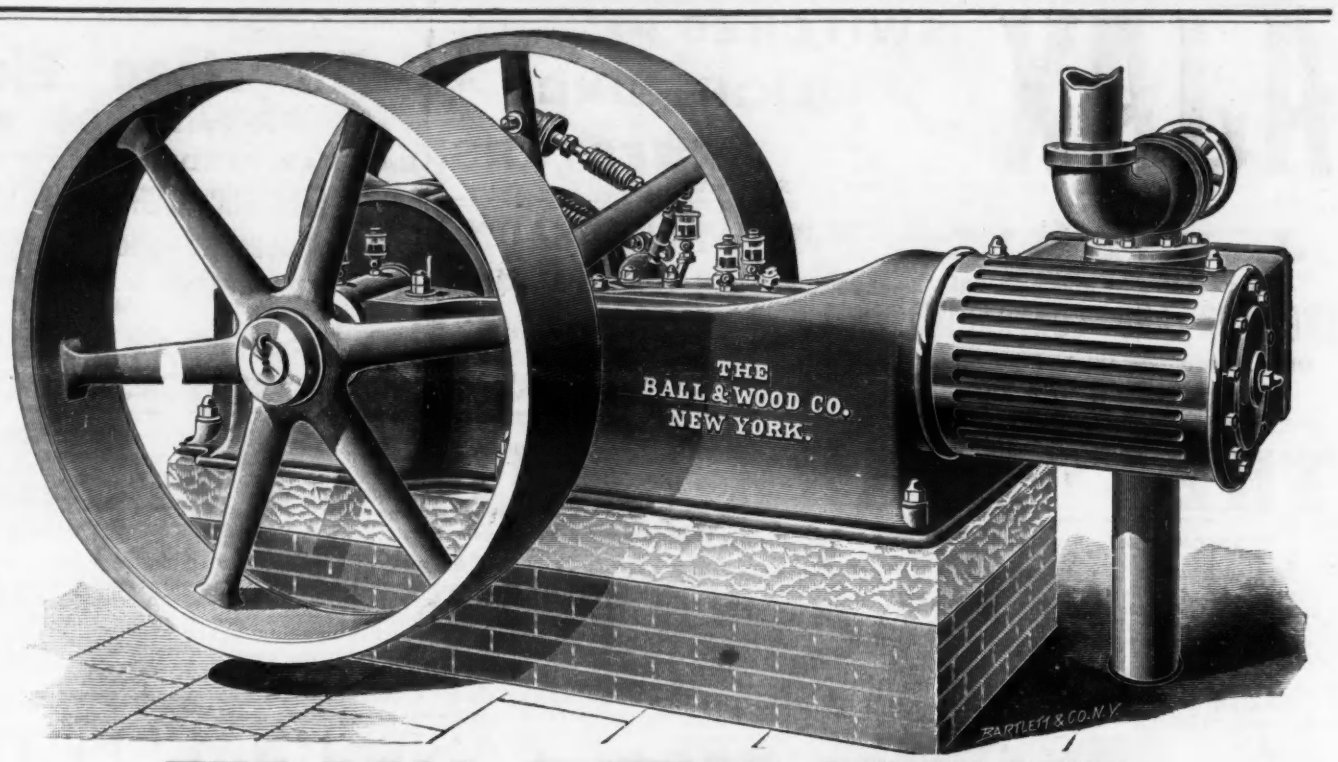

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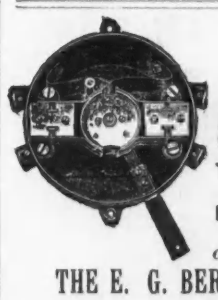
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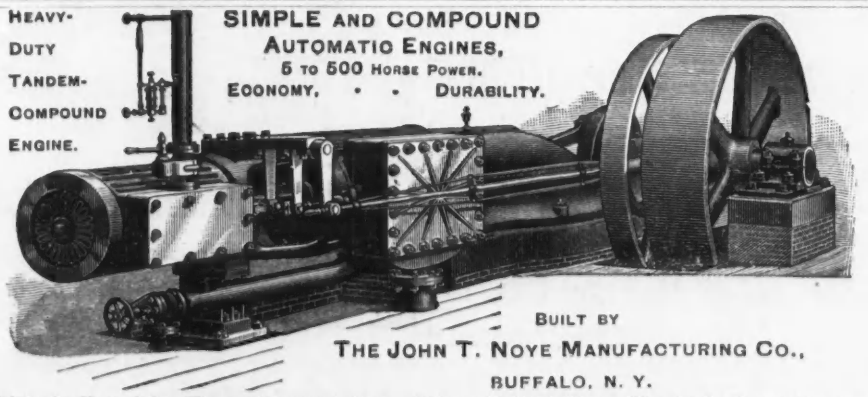

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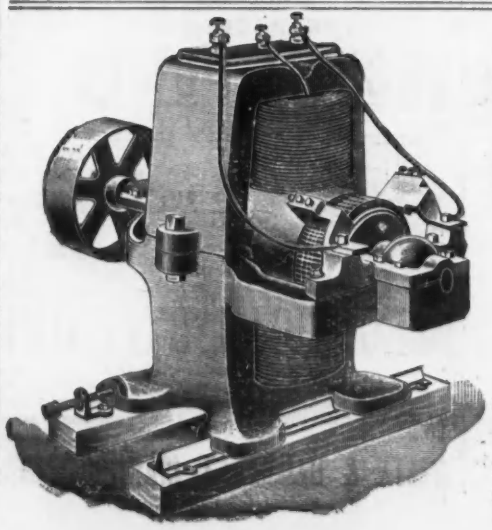

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FUSE WIRE AND LINKS
For all Systems.
Correct Carrying Capacity. Absolutely Uniform.

Order of Your Supply Dealer or Send for Catalogue.
A Large Stock in all Sizes Constantly on Hand.
SPERRY ELECTRIC MINING MACHINE CO.,
39th St. and Stewart Ave. Chicago.

The Kolon Primary Battery

A line of KOLON PRIMARY BATTERIES for the Summer Trade will soon be announced.
The demand for different sizes at varying prices—BUT WITHOUT IN ANY WAY SACRIFICING THE FEATURES WHICH HAVE CONTRIBUTED TO THE KOLON'S POPULARITY—will be fully met.

SPECIALTIES

BATTERIES FOR FAN MOTORS.
BATTERIES FOR SEWING MACHINE MOTORS.
BATTERIES FOR SMALL INCANDESCENT PLANTS.
BATTERIES FOR CAUTERY AND DENTAL OUTFITS.

BATTERIES FOR PRACTICAL PURPOSES.

BRYAN, MARSH & CO., 136 Liberty St., New York.

FRICTION CLUTCHES

For Electric Light Stations.
—WRITE FOR CATALOGUE.—
WM. OESTERLEIN, Cincinnati, O.

NOWOTNY ELECTRIC COMPANY,

MANUFACTURERS AND DEALERS IN
Electric Light and Street Railway Supplies.

ARMATURES AND TRANSFORMERS
Rewound, Commutators Refilled, and General Electrical Repairing.

FOR SALE.
SECOND-HAND DYNAMOS AND MOTORS IN GOOD CONDITION

Two 30-Light Ball Arc Dynamos with lamps.
Three 23-Light Fuller Wood Dynamos.
One 55-Light " " Dynamo.
42 Double Carbon Lamps.
28 Single " "
One 10-Light Smith Dynamo.
One 40-Light Easton 110-Volt Incandescent.
One 125-Light Queen City 220-Volt "
One 85-Light Mather 110-Volt "
One 45-Light Jenny 110-Volt "
One 50-light Old Style Edison 110-Volt Incandescent.
One 60-Light Cultan 110-Volt Incandescent.
One 10-H. P. 220-Volt Queen City Motor.
One 8-H. P. 500-Volt Card Motor.
One 5-H. P. 110-Volt Mather Motor.
One 5-H P. 220-Volt Sprague Motor.
One 2½-H. P. 220-Volt Barrett Motor.
Two 1-H. P. Arc Ford-Washburn Motors.
Five ¼-H. P. 110-Volt Triumph Motors.
One ⅛-H. P. 110-Volt Card Motor.
Three 1-H. P. 110-Volt Smith Motors.
One 1-H P. 500 Volt Eddy Motor.
One ⅓ H. P. 110-Volt Hauss Motor.
One 1-H. P. Excelsior Arc Motor.
Three 2-H. P. Excelsior Arc Motors.
One 1-H. P. Baxter Arc Motor.
One 1-H. P. Card Arc Motor.

SEND FOR PRICES.

30 East Fifth Street, = = Cincinnati, O.

FOR SALE.

By the Jefferson Electric Light, Heat and Power Co., of Punxsutawney, Pa.; seven reels, 3,175 No. 3 braid line wire B. & S.—about 8,325 feet No. 0; eleven reels, 3,359 No. 3 braid line wire, B. & S. No. 1. This wire is new and on reels as it came from A. B. & C. Co. factory; will be sold at a reduction. Address
JEFFERSON ELECTRIC LIGHT, HEAT AND POWER CO., Punxsutawney, Pa.

FOR SALE, CHEAP.

Two 100-h. p. Dick & Church engines; two 100-h. p. Manning boilers; one 200 h. p. heater; one 60 ft. smokestack; one deep well Cameron pump; twenty feet 4-in. shafting; three 36-in. pulleys; all now in running order; can be seen any night; cause for selling, putting in more power.
C. B. AUTES, SUPT.,
MONONGAHELA ELECTRIC LIGHT & POWER CO.,
Homestead, Pa.

WE HAVE FOR SALE

The following material in first-class condition:
Incandescent Dynamos.—One 350-light, one 250-light, and one 270-light, 110 volt, Edison; one 250-light, one 150-light, one 400-light and one 600-light Brush; one 250-light U. S.; one 45-light and one 250-light T.-H.; two 250-light and one 45-amp., 80 volt., Eickemeyer Dynamos; one 150-light and one 250-light Richter Dynamo; one 350-light, 125-volt Edison Dynamo, shunt wound.
Arc Dynamos.—One 50-light American and lamps; one 20-light (with lamps) and one 10-light, U. S.; one 70-light 800 c. p. Ball with lamps; one 30-light Ball with lamps.
Motors.—Two 3 h. p. 220-volt, two 5 h. p. 220-volt Thomson-Houston, and one 7½ h. p. Daft, new.
Engines, Boilers.—One 65-h. p. Ball engine; one 14-h. p. Westinghouse standard engine; two 75-h. p. boilers (Lake Erie Boiler Works), new; two Snow pumps, 10 x 6 x 10, brass fittings, new; one 15-h. p. Otto gas engine; one 9½ x 12 Armington & Sims automatic engine; one 7½ h. p. Otto gas engine.
We buy and sell all kinds of electrical apparatus and supplies.
ROSSITER, MacGOVERN & CO.,
39 Cortlandt St., N. Y.

DYNAMOS FOR SALE.

Our list of Second Hand Electric Light Apparatus will appear in next week's issue of this journal. See also last week's issue.

Rose Electric Light Supply Co.,
ST. LOUIS, MO.

IF YOU WANT

A NIAGARA DYNAMO OR MOTOR, or if you are a dealer and want an Agency, send for our Catalogue and Price List,

LOVELL MFG. CO., Ltd., Erie, Pa.

Automatic Gas and Gasoline Engines,

Improved Storage Batteries, Dynamos, Complete Lighting Plants, Stores, Residences, Country Places, etc.; Electrical Supplies, Physicians' and Dentists' Apparatus. Write for prices, catalogues, etc.

H. A. KINNEY,
Hammond Building, Detroit, Mich.

(Other FOR SALE Advertisements see page xxiv).

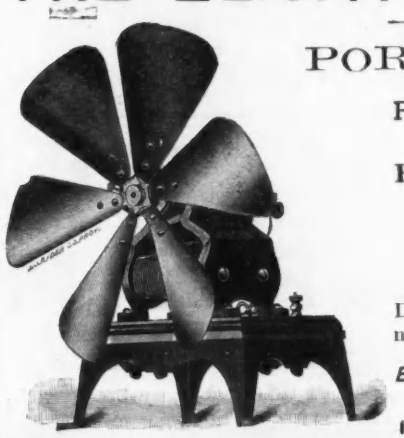
THE WOOLVERTON ELECTRIC CO.

REWIND **ARMATURES** of every system. We overhaul and rebuild alternating and direct current dynamos, arc lamps, transformers, commutators, railway generators and street car motors of every system.

78-80 IRVING ST., RAHWAY, N. J.

THE LEAVITT MOTOR CO.,

—SUCCESSORS TO—
PORTER & LEAVITT.



FAN AND BATTERY MOTORS
A SPECIALTY.
FOUR REGULAR SIZES.

No. 1, 2 Volts, 1-32 h. p. $3.00
No. 2, 4 Volts, 1-16 h. p. 5.00
No. 3, 6 Volts, 1-12 h. p. 10.00
No. 4, 10 Volts, 1-8 h. p. 15.00

Suitable for running Sewing Machines, Dental Drills, Jewelers' Lathes and all kinds of light machinery.

EVERY MOTOR GUARANTEED. SEND FOR CIRCULAR.
OFFICE AND FACTORY:
124 MITCHELL ST., PROVIDENCE, R. I.

BRASS

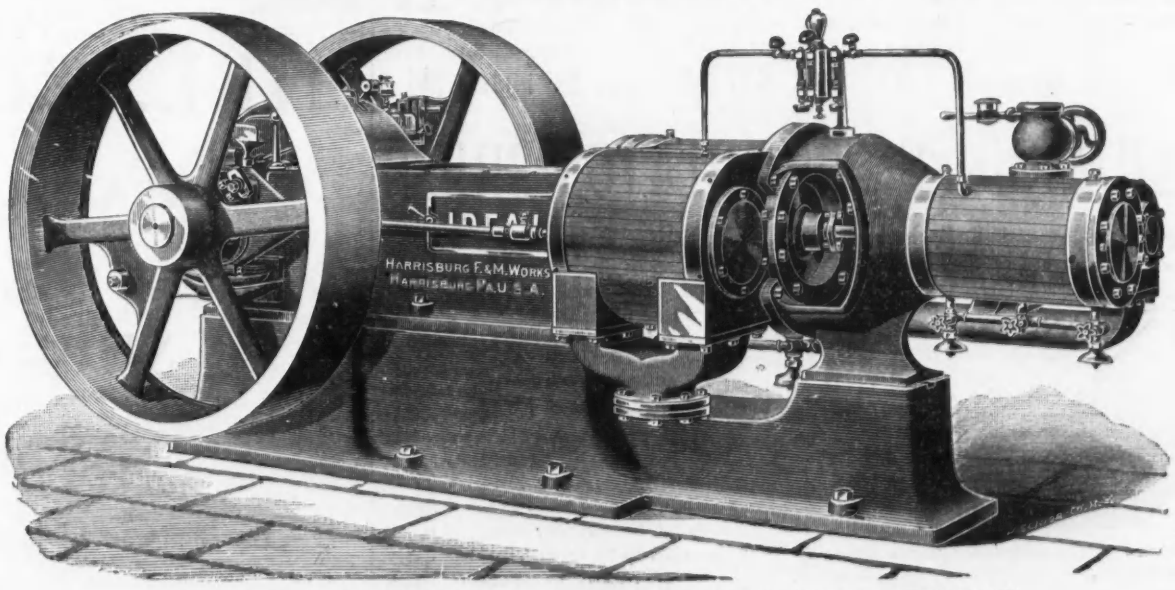
WORKING MACHINERY.

Plain Monitor Lathes. Friction Clutch B. G. Monitors. Fox Monitors, Complete.

THE LODGE & SHIPLEY MACHINE TOOL CO.,
CINCINNATI, O., U. S. A.

HARRISBURG FOUNDRY AND MACHINE WORKS

General Office and Works: HARRISBURG, PA., U. S. A.



THE HARRISBURG IDEAL TANDEM COMPOUND ENGINE.
AUTOMATIC LUBRICATION. SUPERIOR REGULATION. PERFECT EQUILIBRIUM IN ACTION. HIGHEST ECONOMY

SELLING AGENTS:

W. R. FLEMING & CO.,
New York and New England.
NEW YORK OFFICE, Mail & Express B'd'g.
BOSTON OFFICE, 620 Atlantic Ave.
(Walter W. Jones, Manager.)

F. E. BAILEY, PHILADELPHIA,
24 S. 7th St., Builder's Exchange.

H. E. BALDWIN, CINCINNATI,
Perwin B'd'g, 5th and Race Sts

FOR SALE.

Second-hand arc and incandescent dynamos. Motors for all circuits. Send for list and prices. E. C. KETCHUM,
178 Devonshire St., Boston, Mass.

FOR SALE.

Quick for cash or short term payments four horizontal return tubular boilers 72 diameter by 20 feet long, rating 150 h. p. each Boilers are made of highest grade firebox steel. Longitudinal seams "butt" strapped with six rows of rivets. Good for 125 pounds steam and guaranteed to insure at that. Boilers were intended for increase to large battery now decided not to build and are still at our shop. Will be sold at absolute cost Full drawings and specifications will be sent to interested parties
J. W. PARKER & CO.,
41 North Seventh St., Philadelphia, Pa.

FOR SALE.

Engines and Boilers.—One 25-h. p. Centre Crank Engine, nearly new—horz; two 80-h. p. Centre Crank Engines, Automatic High Speed; one 0-h. p. Centre Crank Engine. Automatic High Speed; two 60-h. p. Centre Crank Engines, Automatic high Speed; one 150-h. p. Centre rank Engine. Automatic High Speed; one 100-h.p. Corliss Engine, 16-42, second-hand; one 50-h. p. Double Cut-Off Engine, second-hand; one 10-h. p. Locomotive Boiler, second-hand; one 4-h. p. Vertical Boiler, second-hand; one 8-h p. Vertical Boiler, second-hand; six 7-h. p horz; Tubular Boilers, entire new fixtures; one 100-h. p. horz. Tubular Boiler.

Dynamos and Motors.—One 75-light 125 V. United States Dynamo, new; one 15-light 125 V. United States Dynamo, new; one 250-light 125 V. United States Dynamo, new; one 250-light 75 V. Thomson-Houston Dynamo, S. H. Compound; two 250 light 70 V. United States Dynamos, S. H. Shunt; three 250-light 110 V. Eickemeyer Dynamos, S. H. Shunt; two 4 0-light 96 V. Brush Dynamos S. H. Compound; one 6 0-light 96 V. Brush Dynamo S. H. Compound; one 6-light 110 V. Brush Dynamo, S. H. Compound; six 0-light 2000 c. p. Knowles Dynamos; eight 3-light Westinghouse Arc Dynamos; one 50-light American Arc Dynamo; two 20-k. w. Edison Inc. Dynamos. 350 lights; one Cleveland Inc. Dynamo, 180 lights; S. H Compound; one 3-h. p. T.-H. Motor, 220 V; one 5-h. p. T.-H. Motor, 220 V; one 30-h.p. C. & C. Motor, 220 V; one 2-h. p. Sprague Motor, 220 V; one Blake Ore Crusher.

We Buy Outright Electrical Equipment.

John E. Beggs Mfg. & Supply Co.,
71 CORTLANDT STREET, N. Y.

Any company contemplating the expenditure of a large amount in the establishment of a manufacturing industry, requiring the use of a thoroughly equipped Macnine shop, Boiler shop, Foundry and Smith shop plant, well located on competing trunk lines of railroads and in a good labor market, is invited to address
STIMSON, WILLIAMS & CO.,
Bryant Bldg., 55 Liberty St., New York City.

FOR SALE, CHEAP.

Sixty-light Edison Dynamo and 5-h. p. Case Engine; both in excellent condition; in use only for short time. Call on or address
THE PUBLISHERS' PRINTING CO.,
132-136 West 14th Street,
New York City.

BIDS WANTED.

Bids for lighting the streets and highways of the Woodhaven lighting district, in the town of Jamaica, with "car lights" for the term of five years, will be received by the undersigned, at his office in the Town Hall, village of Jamaica, until 10 A. M. of July 7, 1893. The town board reserves the right to reject any or all bids. For form of bid, proposal, etc., apply to
JAMES F. McLAUGHLIN,
Town Clerk, Jamaica, N. Y.

PROPOSALS:

CITY OF LYNN,
Clerk of Committees' Office,
June, 1893.

Electric Fountain.

Sealed proposals addressed to Chas. W. Gay, City Engineer, will be received by the City of Lynn until 5 P. M. July 7, 1893, for constructing and erecting an electric fountain in accordance with design, detailed plans and explanatory text to be submitted with each proposal and at a cost not exceeding $2,000.

An acceptable bond or equivalent, in amount $500, must accompany each bid, guaranteeing the successful bidder's signature to a contract before July 14, 1893; also the erection and successful operation of the fountain prior to Sept. 1, 1893.

For further information apply to said City Engineer. The right is reserved to reject any or all designs or proposals.
CHAS. H. SPEAR,
Clerk of Committees.

PROPOSALS.

TREASURY DEPARTMENT,
WASHINGTON, D. C., June 15, 1893.

Sealed proposals will be received at this Department until 2 o'clock P. M. Wednesday, June 28, 1893, for wiring the U. S. Post Office and Sub-Treasury building, Boston, Mass., for a system of electric lighting. Plans and specifications can be seen at the office of the Custodian of the Post Office and Sub-Treasury building, Boston, Mass., from June 21 to 26, 1893, inclusive. The Department reserves the right to reject any or all bids and to waive defects, or to accept any bid in whole or in part, within the next thirty (30) days. Partial bids will not be considered. Proposals should be addressed to the Secretary of the Treasury, Washington, D. C., and indorsed: "Proposals for Wiring U. S. Post Office and Sub-Treasury Building, Boston, Mass."

J. G. CARLISLE, Secretary.

L. F. Rondinella, M. E.,

705 CHESTNUT ST., PHILADELPHIA.

Electrical, Mechanical and Civil Engineer.

Prof. Drawing Phila. Manual Training School; Secretary of the Engineers' Club of Philadelphia.

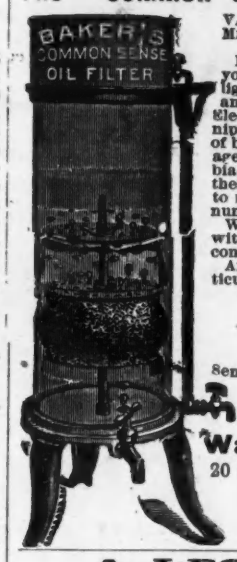
Steam and Electric Plants, Surveys, Maps. Special Machines, Tests, Reports, Expert Draughting.

SIX IMPORTANT NEW BOOKS.

Heaviside's Electrical Papers. 2vols..	$10.00
Hopkinson's Original Papers on Dynamo Electrical Machinery and Allied Subjects	1.00
Kempe's Handbook of Electrical Testing. Fifth edition	7.25
Lodge's Lightning Conductors and Lightning Guards	4.00
Maxwell's Treatise on Electricity and Magnetism. Third edition, with notes by J. J. Thomson. 2 vols.	8.00
Sprague's Electricity: Its Theory, Sources and Applications	6.00

THE W. J. JOHNSTON COMPANY, Limited,
41 Park Row (Times Building), New York.

The "Common Sense" Oil Filter



VANCOUVER B. C., April 10, 1891
MR. W. E. CRANE,
Minneapolis, Minn.

DEAR SIR I noticed one of your Oil Filters at the electric light works in Calgary Alta, and also one at the Northwest Electric Light Works in Winnipeg, and as I am in that line of business here I would like the agency for it for British Columbia. I feel sure if they are what these parties represented them to me to be I can sell quite a number of them.

Would you please furnish me with circulars, discounts and commissions?

An early reply with full particulars will oblige,
Yours very truly
A. Q. ST. GEORGE,
Manufacturers' Agent.

—»:«—

Send for Circular, Reduced Price List and Discounts to

Walter E. Crane,
20 Beach St., Hartford, Conn.

F. H. Alling,
19 West 13th Street,
New York Agent.

A. LEOFRED,

MINING ENGINEER.
Head Office: QUEBEC.
Branch Office: SHERBROOKE.
Branch Office: MONTREAL, 17 Place d'Armes Hill.
(Graduate of Laval and McGill.)
Mines, Mineral Products.

BOSTON GEAR WORKS

36 Hartford St., Boston, Mass

HEADQUARTERS FOR GEARS.

Book on Gears, 170 Illustrations, $1.00. Job Gear Cutting of all kinds. Spur, Bevel, Spiral, Ratchet, Worm, Rack, Elliptic, Index Plates, etc. Very small or large. Send for 1892 Catalogue. 1100 sizes of Gears. TRY OUR NOISELESS FIBEROID GEARS.

SILK WIPERS.

Just the thing for **Dynamos, Motors, Commutators,** and all kinds of machinery. For polishing it is superior to either cotton, woolen, rag or chamois. A saving at least of 75 per cent. Exclusively used by Edison Electric Co., of Philadelphia, and many others. For further particulars address
AMERICAN SILK MFG. CO.,
311 Walnut St., Philadelphia.

H. N. H. ELECTRIC CO.,

136 LIBERTY STREET, NEW YORK.

Highest Efficiency. Least Weight. Best Finish.

FAN MOTORS.

Carbon Brushes. Armored Field. Laminated Throughout.

NEWEST, BEST AND CHEAPEST.
Brooklyn Electric Equipment Co., 164 & 166 Montague St., Sole Agents for Long Island.

CRANES.

Power Bridge Cranes.
Hand Bridge Cranes.
Jib Cranes.

Portable Hoist
Holds load at any point.

MARIS & BEEKLEY
MANUFACTURERS.
PHILADELPHIA, PA.

Overhead Track, Trolleys, Switches.

BOOKS

on electrical subjects mailed to any address in the world, POSTAGE PREPAID, on receipt of price. Catalogue of Electrical Books free.
Address THE W. J. JOHNSTON CO., Ltd.,
Times Building, N. Y.

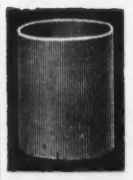
NEW YORK CARBON WORKS,

MANUFACTURERS OF
Carbon Plates, Carbon Cylinders and Motor Brushes.
SOLE MANUFACTURERS OF CARBON CYLINDERS,
UNDER HOLTZER PATENT.
18 Cortlandt St., Telephone Building, New York.

INSULATED WIRE.

Chicago Insulated Wire Co.,

—MANUFACTURERS—
WEATHERPROOF AND MAGNET WIRES
214 Northern Building, Chicago, Ill.



POROUS CUPS.

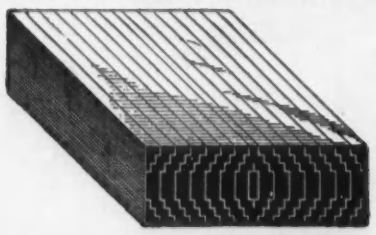
NEW ENGLAND POTTERY CO., 146 Condor St., E. Boston, Mass
Porous Cups in sizes from 1⅛ in. diameter by 3 in. high to 7 in. by 9⅛ in. high.
SPECIAL SHAPES IN QUANTITIES MADE TO ORDER.

TEST BATTERIES

Containing CHLORIDE OF SILVER DRY CELLS
More than 20,000 of These Cells Now in Use by Leading Electricians.
For sale by all leading Electrical Supply Houses in the U. S. and Canada. For price list address
THE CHLORIDE OF SILVER DRY CELL BATTERY CO., Baltimore, Md.
Mention THE ELECTRICAL WORLD.

THE MILWAUKEE COMMUTATOR BRUSH

A SELF-LUBRICATING BRUSH for use on dynamos and motors, which does not spark, and which runs with a minimum of wear on either brush or commutator. Used by several of the largest manufacturers and hundreds of central stations and owners of electrical machinery. Made of graphite and electro-deposited copper. Scientific, rational and a veritable boon to dynamo attendants.



THIS BRUSH CANNOT BE USED ON THE TANGENT, as is customary with copper brushes but we send with each set a special universal holder which can be instantly applied to any dynamo. Motors or generators already using radial holders do not need the special holder. Send exact **length, thickness** and **width** of brush now used, state if used vertically or on the tangent, and we will send a set for trial, to be returned if not satisfactory. Price list and description on application. Made for incandescent machinery and railway generators only.

SOLE MANUFACTURERS:
Wisconsin Electrical Construction Co., Milwaukee, Wis.

HILL, CLARKE & CO.

MACHINE TOOLS.

Lathes, Planers,
Milling Machines,
Drill Presses,
Screw Machines,
Bolt Cutters, Etc., Etc., Etc.

156 OLIVER STREET, - BOSTON, MASS.
CHICAGO BRANCH, 14 SOUTH CANAL ST.

OUR

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUTS

ARE

RELIABLE, ECONOMICAL, SIMPLE,

AND REQUIRE ONLY ONE SMALL WIRE.

ELECTRIC SELECTOR & SIGNAL COMPANY,

(Successor to ELECTRIC SECRET SERVICE CO.),

45 BROADWAY, - - - NEW YORK.

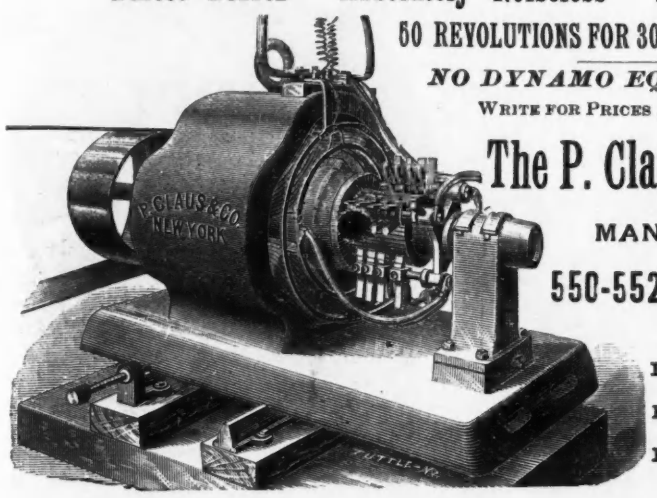
MULTIPOLAR DYNAMOS.

Direct Driven—Absolutely Noiseless—Slow Speed.

50 REVOLUTIONS FOR 300 AMPERES, 110 VOLTS.

NO DYNAMO EQUAL TO THIS.

WRITE FOR PRICES AND CATALOGUE TO



The P. Claus Dynamo Co.

MANUFACTURERS,

550-552 West 36th St., N. Y

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BLODGETT BROS., Boston, Mass.
E. H. MURPHY, St. Paul, Minn.
BRADNEY, MORLEY & CO., Tacoma, Wash.

ARNOLD

Electric Railway and Marine Socket.

Flexible and Self-Locking.

LAMPS CANNOT JAR LOOSE.

Specially Adapted for Street Cars, Elevators, Boats, Preventing Vibration in Filaments.

The Standard Socket of the United States Navy, and Used on Its Vessels Exclusively.

Sample Socket mailed on receipt of 40 cents.

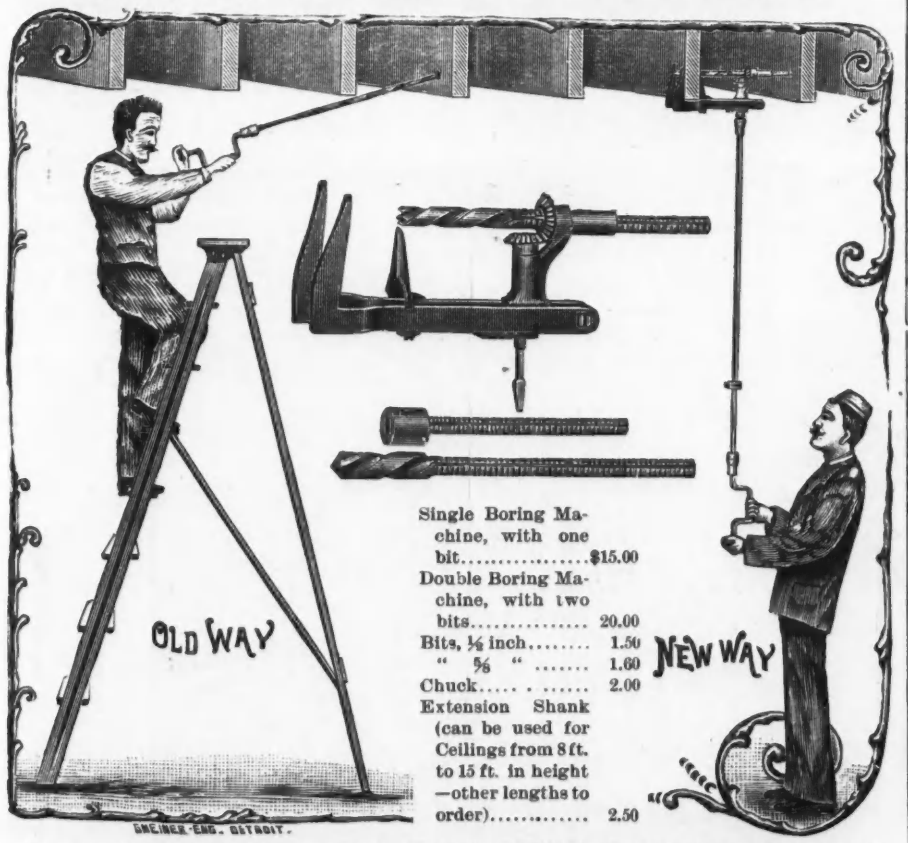
—MADE ONLY BY—

ARNOLD ELECTRIC MANUFACTURING CO., CHESTER, PA.,

Chas. D. Shain, Selling Agent, 136 Liberty St., New York City.

MINER'S BORING MACHINE.

Specially Adapted for ELECTRIC WIRING CONTRACTORS.



Single Boring Machine, with one bit	$15.00
Double Boring Machine, with two bits	20.00
Bits, ½ inch	1.50
" ⅝ "	1.60
Chuck	2.00
Extension Shank (can be used for Ceilings from 8 ft. to 15 ft. in height—other lengths to order)	2.50

For Boring Joists Overhead in Buildings Without the Use of Ladders.

Profitable to Wiremen. Indorsed by Architects and Underwriters.

MINER'S BORING MACHINE is not an experiment, but a practical machine, which have been in use for over a year. It has been found to be very **Profitable to Wiring Contractors** because the boring of holes in joists can be done with less exertion in **one-third the time** than is taken by the old way. By not requiring the use of ladders, time is gained that would be taken in shifting them from place to place, also avoiding the inconvenience and wear and tear of same. By boring holes at direct angles, and at even distance from bottom of joist, the wire end can be tucked through each joist easily, and then can be pulled through from opposite side of room, instead of passing whole coils through one joist at a time, as is caused to be done by boring the old way.

There is a **saving of Wire** in its being stretched straight instead of having kink at each hole, as is made by the old process.

The Single Boring Machine is simple and strong in construction, and weighs less than four pounds.

The Double Boring Machine bores two holes at same time, and is equally as simple and strong in proportion as the single. Both are **Automatic in Feed,** and adjustable to fit and bore timbers to five inches thick. Different size bits or a chuck can be used.

With the **Extension Shank** placed between it and Brace, it can be adjusted for any height ceiling.

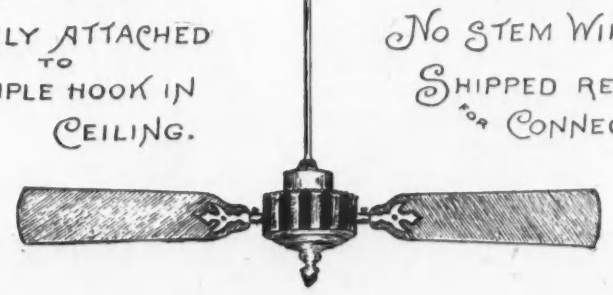
When ordering state whether wanted to be used with chuck, or if with bit direct. For Wiring Contractors it has been found that the machine with ½ inch bit is what is most required.

DETROIT ELECTRIC WIRING AND REPAIR CO., 82 and 84 Griswold St., Detroit, Mich.

The "FeldKamp ELECTRO-MAGNETIC FAN

SIMPLE.
NOISELESS.
NO BURNING OUT.
EASILY ATTACHED TO A SIMPLE HOOK IN CEILING.

DURABLE.
NO SHORT CIRCUITS.
NO ATTENTION.
NO STEM WIRES.
SHIPPED READY FOR CONNECTION.



OUR STOCK ON HAND PERMITS IMMEDIATE SHIPMENTS. CITY AGENCIES CREATED ON SATISFACTORY REFERENCES

CIRCULARS ON APPLICATION TO

ELECTRICAL Piano AND Motor Co.

84-86-88 MECHANIC ST

NEWARK, N.J.

GREAT WESTERN MANUFACTURING CO.

Works: DULUTH, MINN. **General Offices: 195-207 So. Canal St., CHICAGO, ILL.**

—MANUFACTURERS OF—

Arc Lighting Apparatus. ✳ *Direct Incandescent Apparatus.*

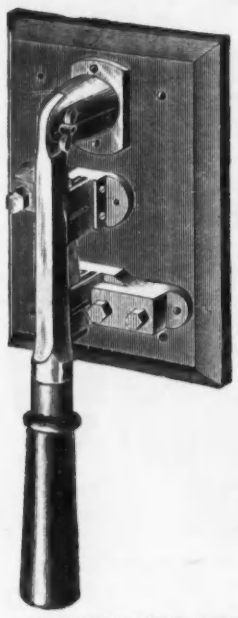
Alternating Incandescent Apparatus.

POWER AND RAILWAY GENERATORS.

General Electrical Supplies and Wire. Gas, Electric and Combination Fixtures of Our Own Designs.

WRITE TO US BEFORE PLACING ORDERS OR CONTRACTS. ☞ ADDRESS DEPARTMENT B.

SPECIAL MACHINERY DESIGNED AND CONSTRUCTED.



MANUFACTURER OF

ELECTRIC SPECIALTIES.

Electric Ceiling Fans.

Fan Motors, Dynamos, Motors, Incandescent and Arc Lamps, Complete Plants.

Cluster Balls, Nickel-Plated Portables, Station Switches, Stage Regulators, Slate and Marble Switchboards. Instruments and Appliances for Electro-Therapeutics. Primary Batteries.

SEND FOR PRICE LISTS.

D. J. HAUSS,

Electrical Engineer and Contractor,
51 Pike Building, CINCINNATI.

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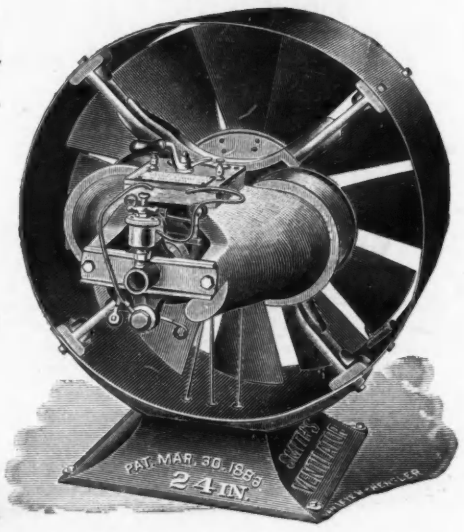
Also furnished with Pulley for Belt Attachment, or Direct Attached Engine if required.



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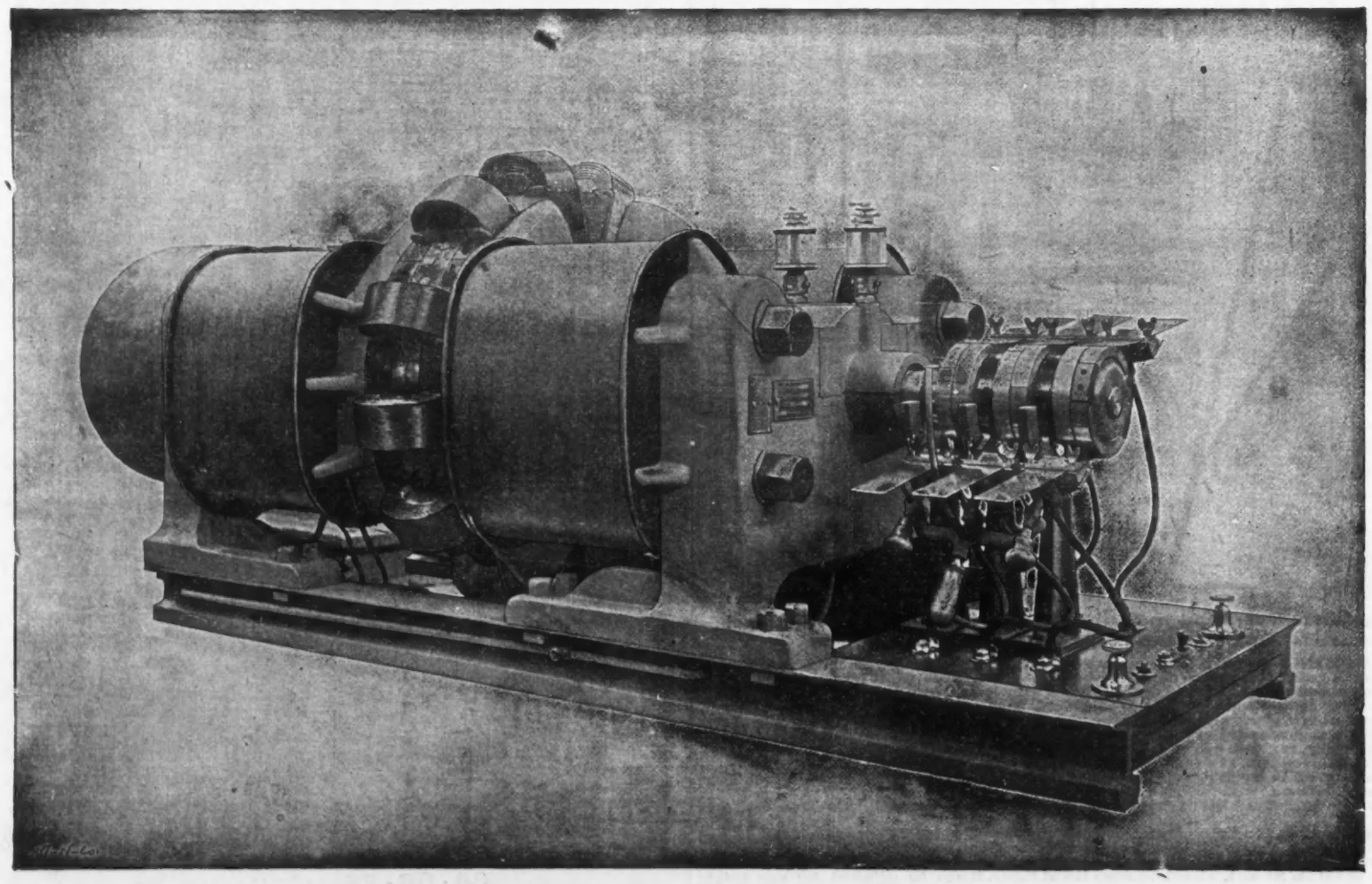

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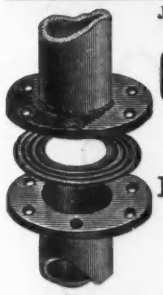

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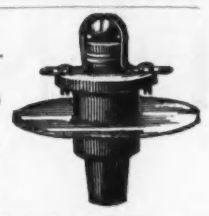

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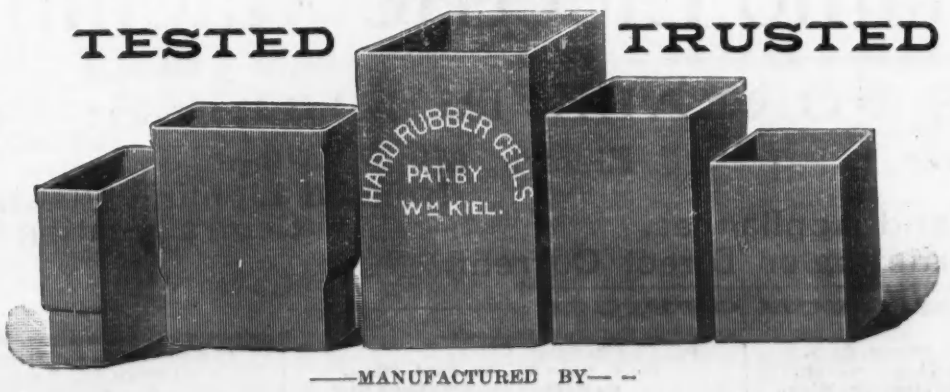

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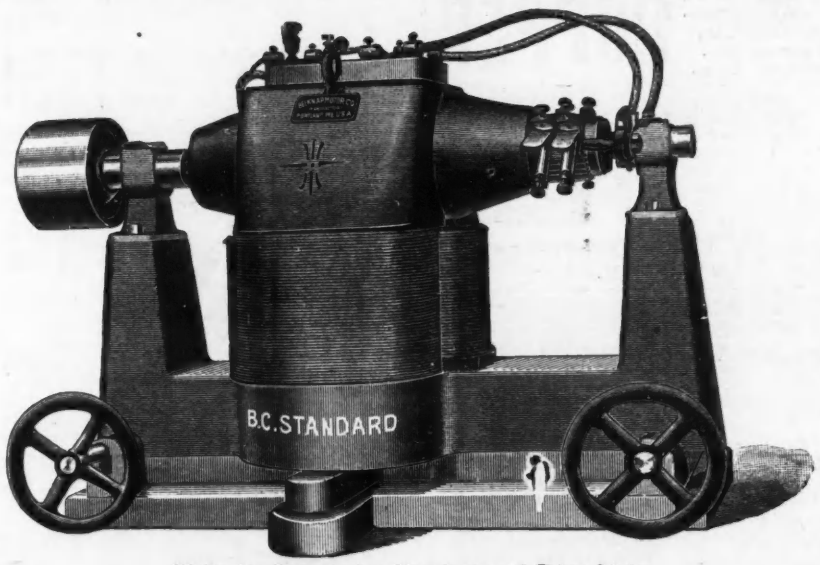

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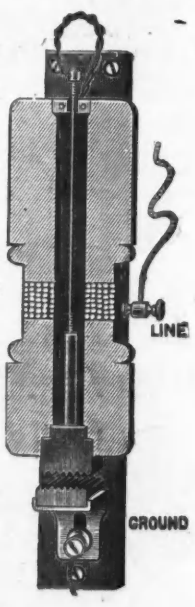

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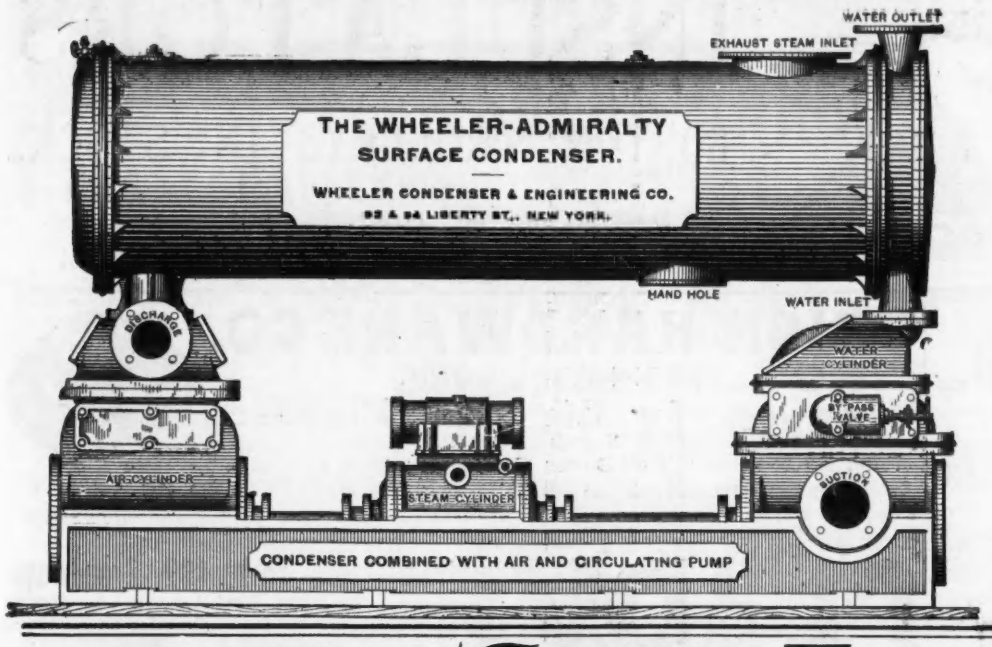

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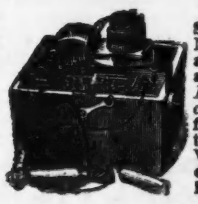

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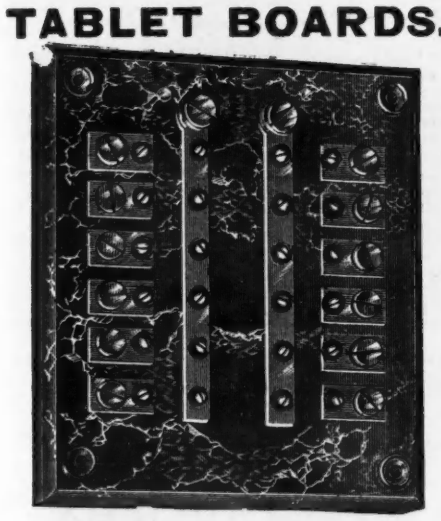

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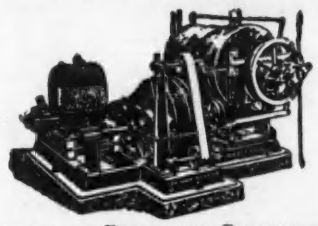

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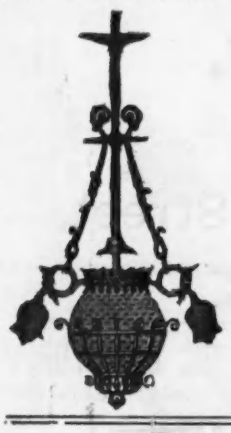

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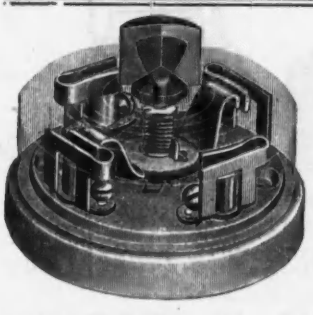

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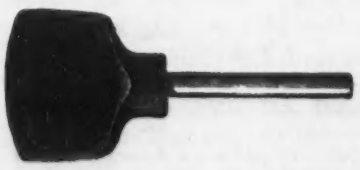

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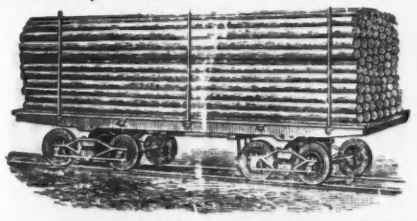

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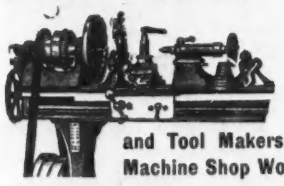

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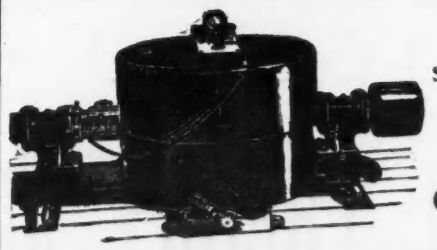

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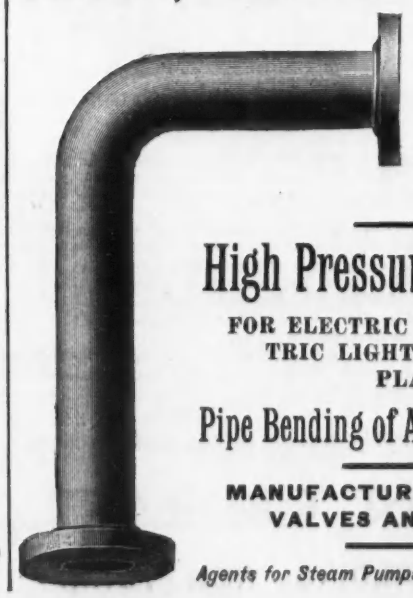

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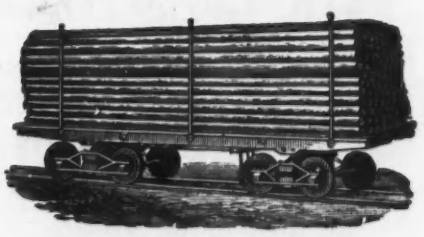

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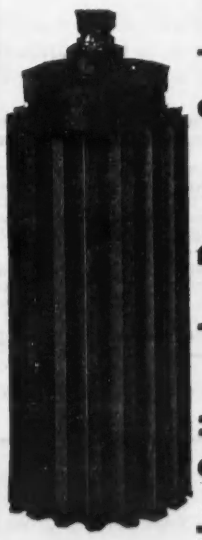

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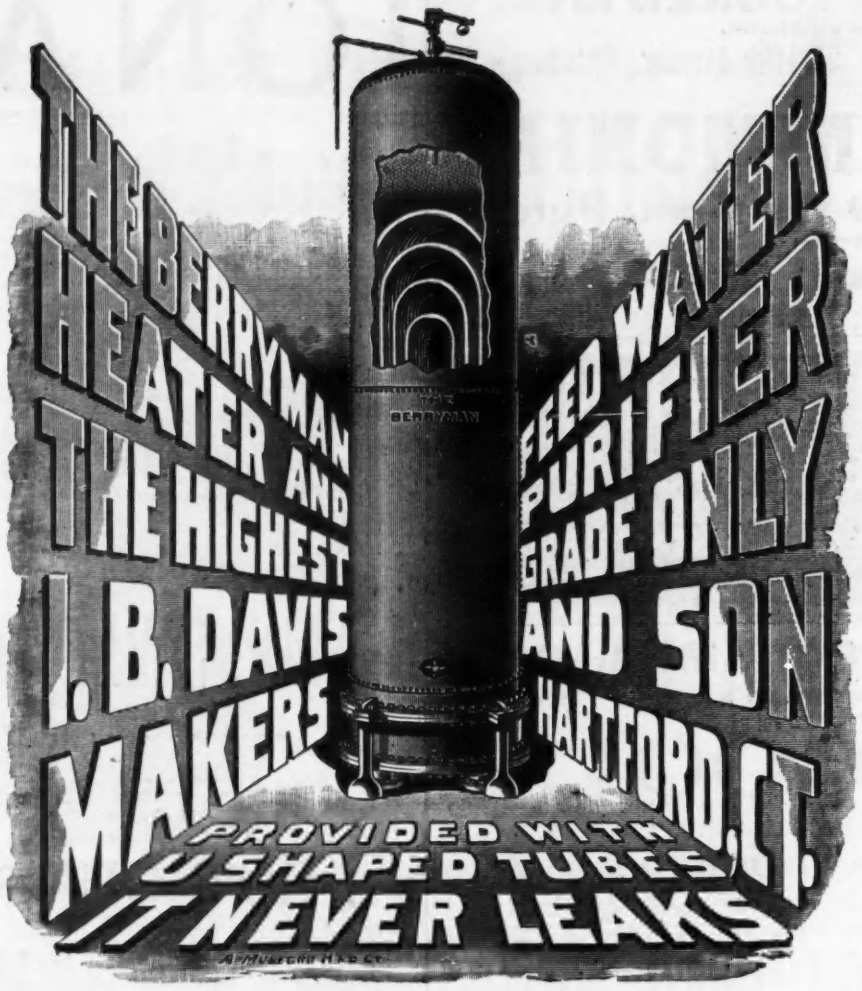

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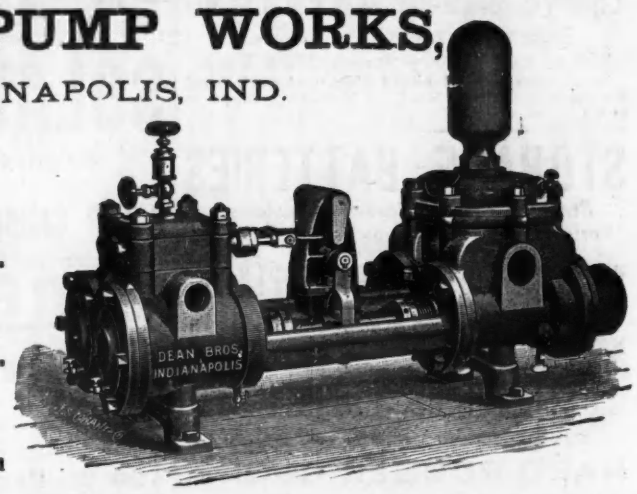

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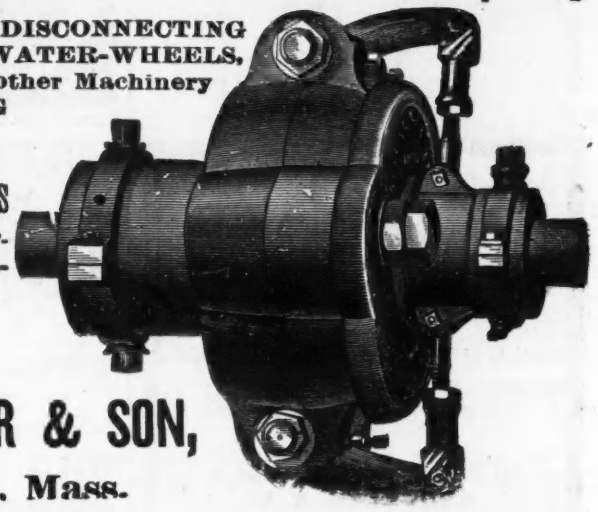

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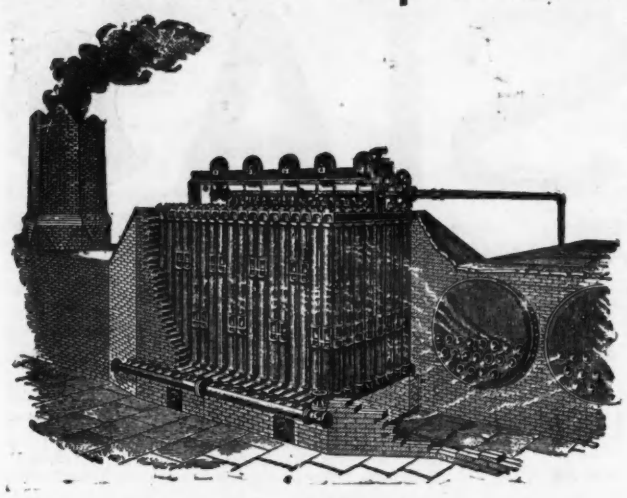

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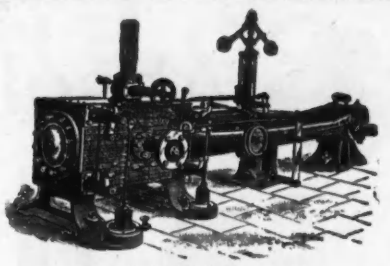

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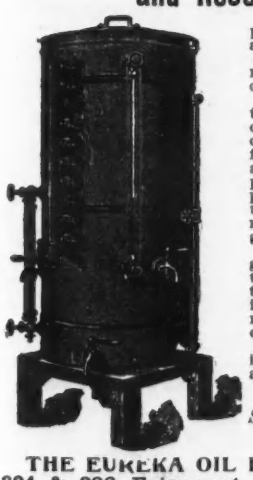

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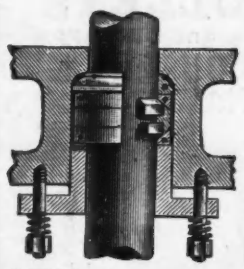

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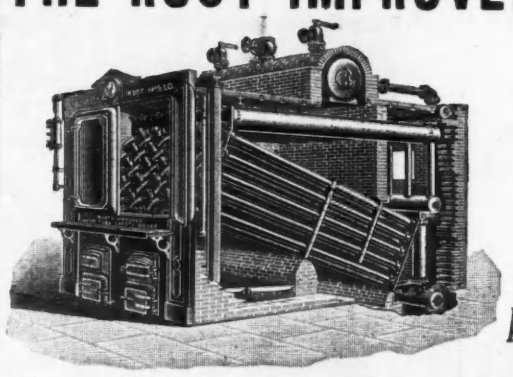

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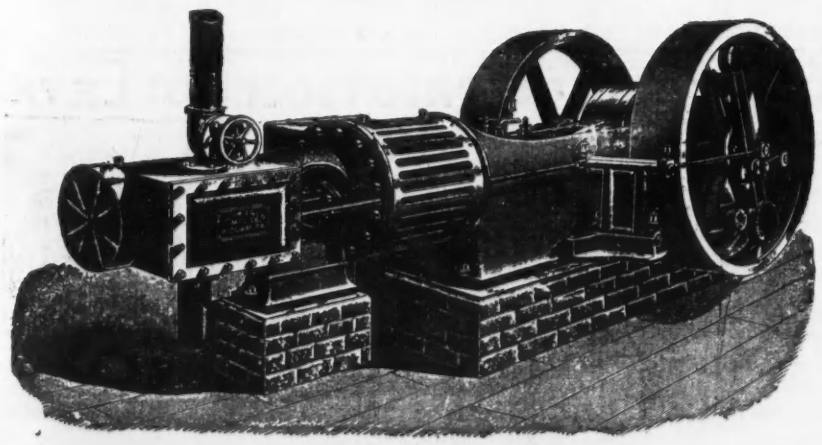

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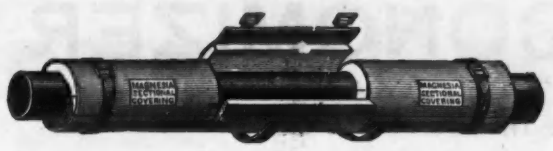
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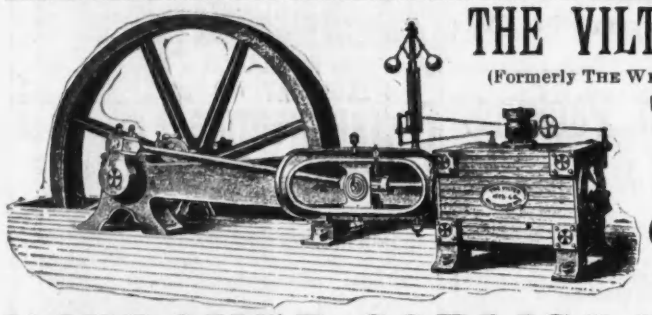

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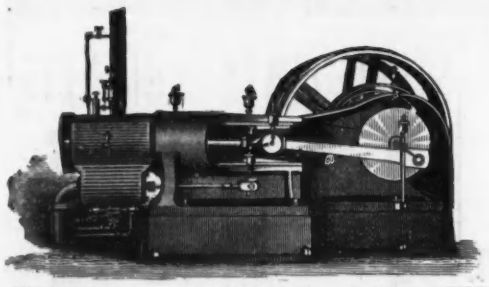

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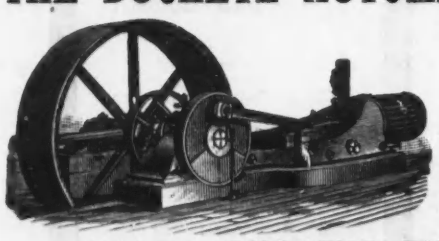

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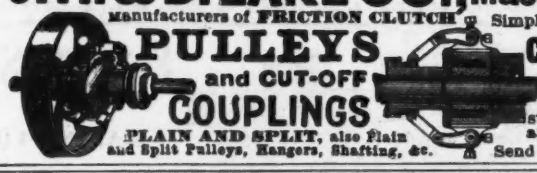

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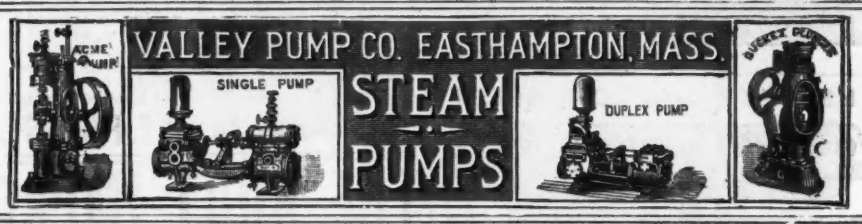

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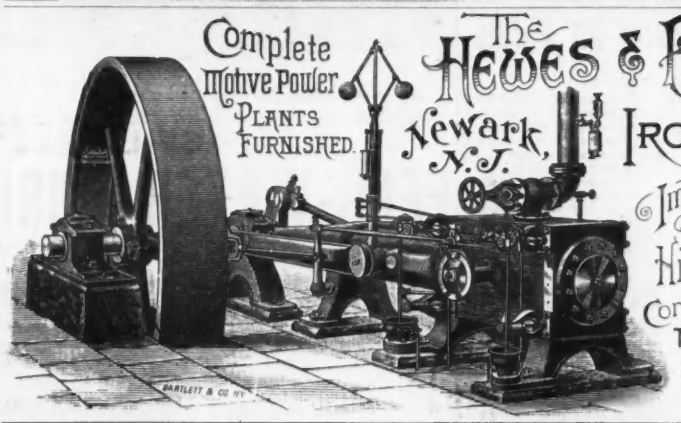

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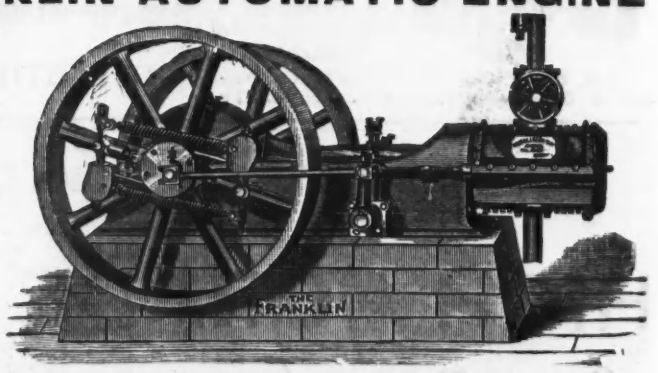

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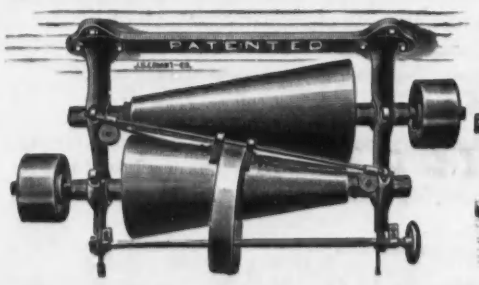

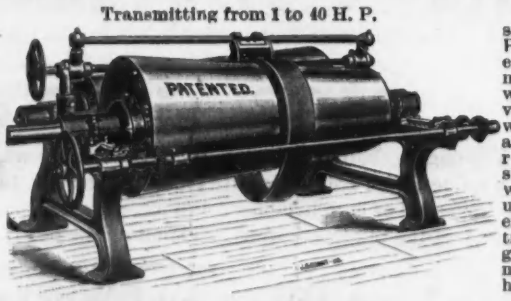

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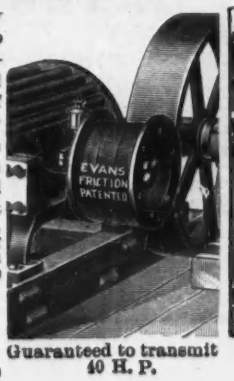

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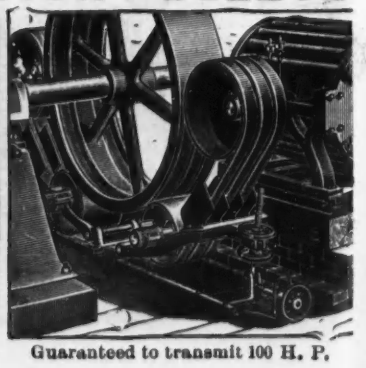

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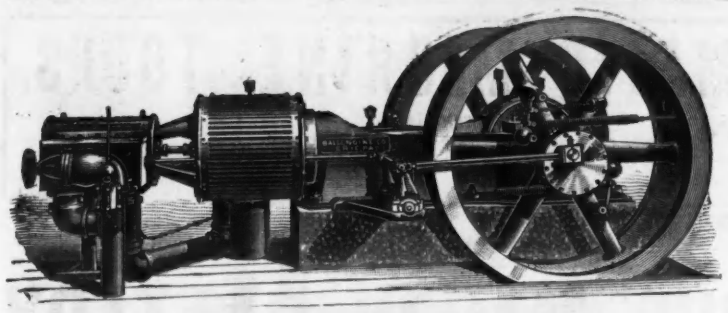

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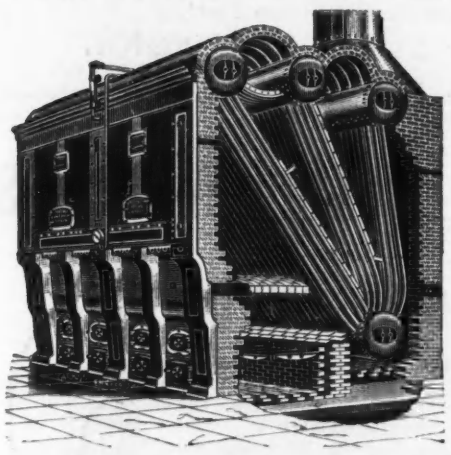

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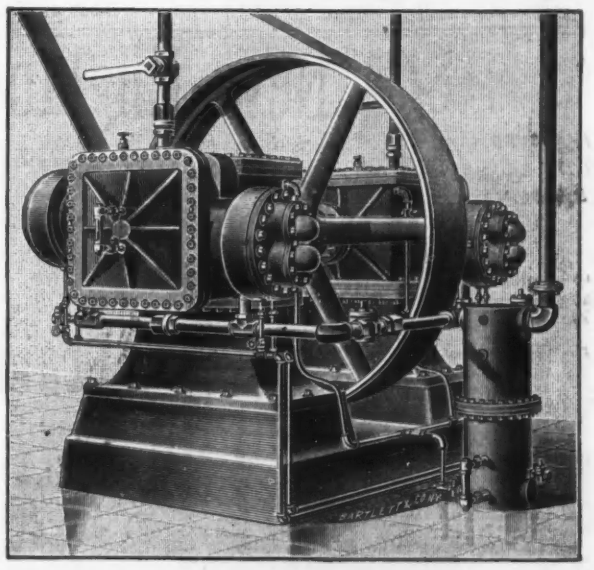

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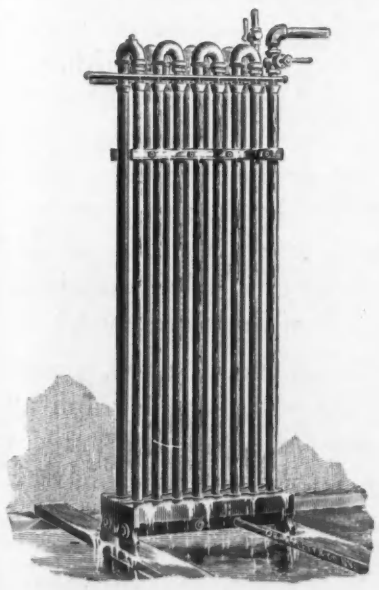

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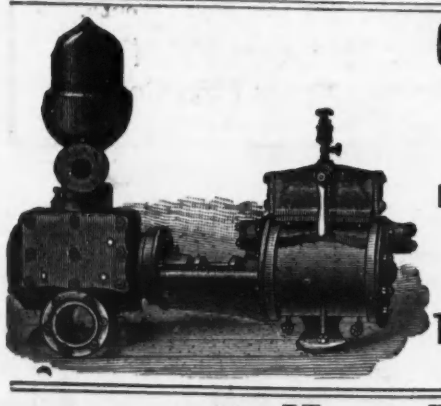

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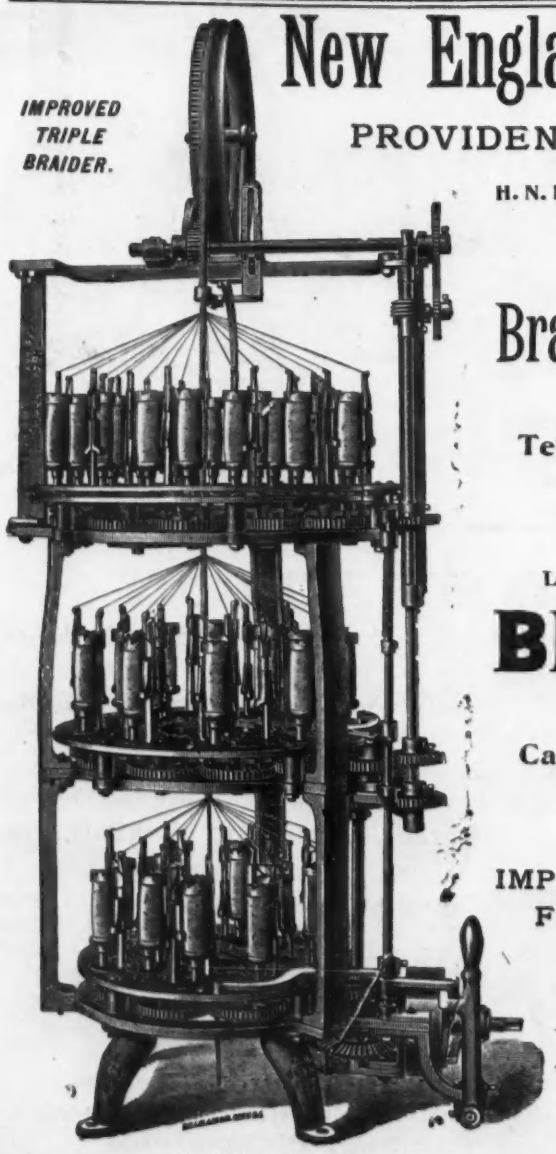

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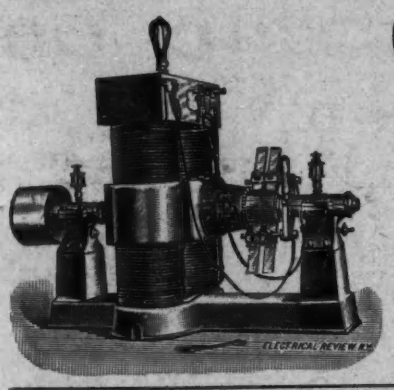

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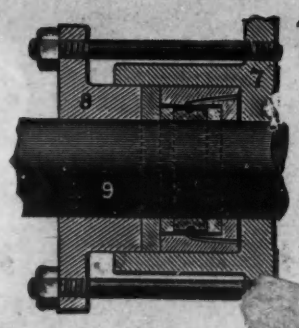

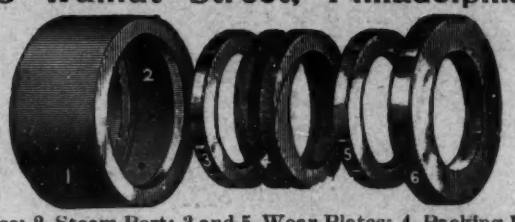

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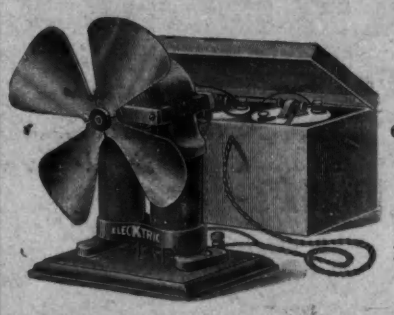

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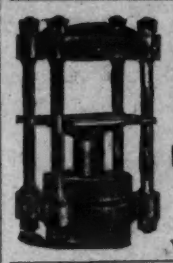

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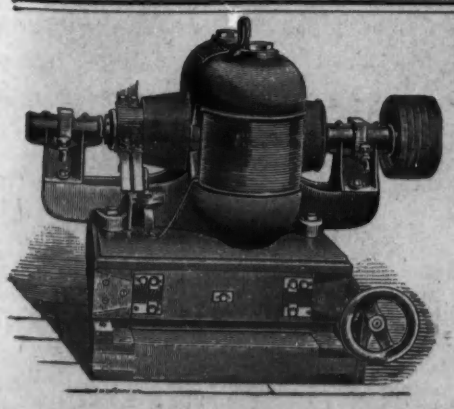

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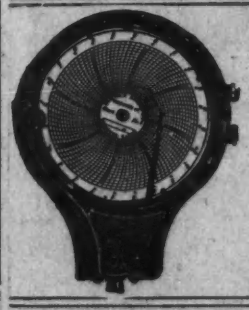

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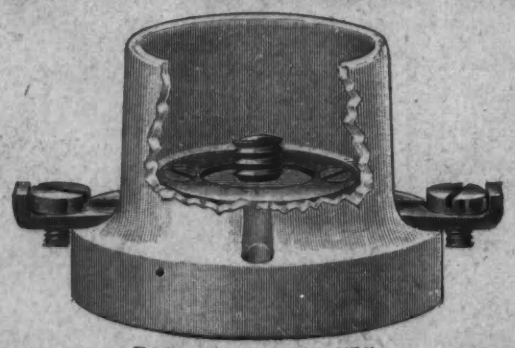

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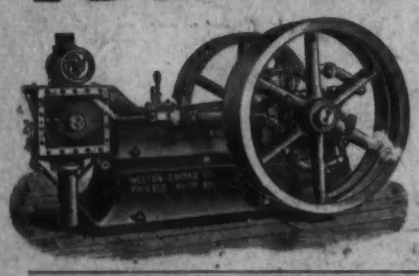

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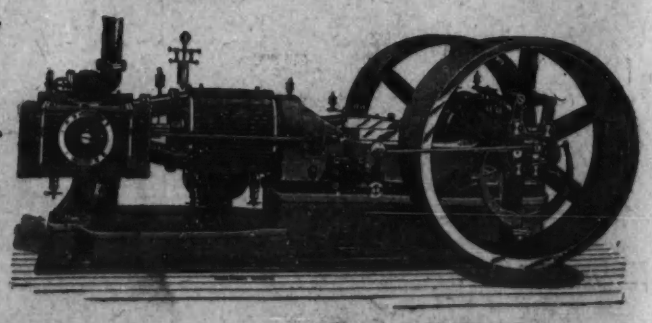

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